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THE NEW-BORN INFANT

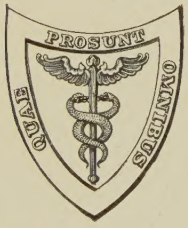
A MANUAL OF

OBSTETRICAL PEDIATRICS

BY

EMERSON L. STONE, M.D.

ASSISTANT CLINICAL PROFESSOR OF OBSTETRICS AND GYNECOLOGY, SCHOOL OF MEDICINE, YALE UNIVERSITY; ATTENDING OBSTETRICIAN AND GYNECOLOGIST TO THE NEW HAVEN HOSPITAL; ATTENDING OBSTETRICIAN TO THE GRACE HOSPITAL, NEW HAVEN



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TO OUR EVERY EFFORT AND IDEAL

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PREFACE.

The welfare of the new generation tends more and more to be secured at every turn. The most remote efforts toward this goal consist in improved health measures of many kinds for actual and potential parents, and these include the more indirect considerations of eugenics and birth control. The fetus, once established *in utero*, is the beneficiary of the greatest single contribution to better obstetrics, prenatal care, and here it may be treated both prophylactically and therapeutically. Again, modern obstetrical technique aims to safeguard the new-born against injury and infection at the time of labor. The science of pediatrics, coupled with its diverse accessories—special clinics, welfare stations and child health legislation—helps to bring down infant and childhood morbidity to a minimum.

There remains a gap in this scheme of adequate care, relatively narrow in time limits, but wide in importance—the first month or six weeks of life. The obstetrician, interested primarily in the surgical branches, tends in most instances to consign the oversight of the new-born infant to the instinctive type of care rendered by the mother or by the attending nurse; or, on the other hand, to seek the advice of the pediatrician when the normally sturdy constitution of the infant is overtaxed. The pediatrician, on the other hand, usually has little opportunity to study the normal infant reaction, not to mention the pathological, for in general the mother does not seek pediatric care for the child until the close of the puerperium. In addition, the opportunity to supervise an obstetrical nursery rarely falls to the pediatrician in his period of hospital training. Thus, there is rarely an individual on the medical faculty who feels keenly the responsibility for transmitting to students a working concept of new-born physiology and pathology, and numbers of men are turned out annually with a narrow viewpoint in this regard.

This condition has been brought about in large part by the tendency of the new-born to adapt itself to its environment in a surprisingly happy fashion, in the great majority of cases. However, it is beyond question that due regard for rational principles of routine care, logical feeding methods, early diagnosis of disease and properly designed treatment will contribute greatly to the general program of infant welfare.

Our observations are freely supplemented by the conclusions of many authors, and there is little room for purely original data, but the present work has two principal aims: (1) To correlate and arrange in orderly fashion a mass of data that is otherwise scattered through a vast medical literature; (2) to emphasize at every possible opportunity the obstetrician's viewpoint and responsibility, to sharpen and extend his interest in this important branch of his work. Herein lies our hope of making an original contribution to medical literature. Obviously, certain important phases of the subject have little purely obstetrical significance, but their inclusion here is essential to a complete presentation of the material.

No one individual could accumulate in a lifetime of practice even a fraction of the experience requisite for a first-hand description of all the commoner aspects of new-born pathology. It is likewise apparent that the principles of general medicine, surgery, bacteriology, metabolism, embryology and many other branches of study are woven into the general subject that we are presenting, and we trust that our limitations in the mastery of such a mass of detail will be viewed charitably.

The material presented is the outgrowth of a short elective course of lectures, offered each year by the Obstetrical Department to the senior class of the Johns Hopkins Medical School. The interest shown in the subject by the majority of the students persuades us to offer it to the profession, in the hope that it may prove to be serviceable in this larger field.

E. L. S.

New Haven, Conn.

FOREWORD.

The following booklet represents an amplification of a course of lectures given in the elective work in obstetrics for fourth-year students in the hope of interesting them in the care of the new-born infant.

Its perusal has interested me so greatly that I am sure that it will have a useful purpose, and I recommend it without hesitation to those interested in the subject.

Unfortunately most obstetricians tend to be interested almost exclusively in the problems offered by the mother and to minimize those presented by the child. On the other hand, the pediatric specialist rarely has the opportunity to supervise large numbers of newly-born infants, with the result that the recognition and treatment of many important diseases and abnormalities occurring in them are deferred to the detriment of the child.

This little book gives an excellent résumé of the manifold problems which may be encountered and should prove particularly valuable to the practitioner who includes obstetrics in his general work.

J. Whitridge Williams.

Johns Hopkins University
Baltimore, Md.

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THE NEW-BORN INFANT.

CHAPTER I.

THE IMMEDIATE CARE OF THE NEW-BORN.

Up to the moment of delivery, the fetus lives a parasitic existence, but with the assumption of an independent career at birth, it undergoes the most profound physiological changes that are encountered at any period of life. Certain of these alterations are immediate and others are delayed, but they are all permanent, and therefore significant. At this point the infant loses the one appendage through which life has been maintained—the placenta. This structure has "breathed, digested and excreted" for the fetus, permitting the organs normally designed for these purposes to lead a latent existence. Here they are suddenly called upon to function independently and in relation to each other. Similarly, the membranes and their enclosed fluid, which have provided throughout pregnancy a protection against mechanical trauma, a lubricating medium to promote unrestricted intra-uterine growth, and an environment maintained at a constant optimum temperature, are lost at delivery, again demanding of the child a rapid adaptation to the new situation.

Of first and immediate consequence is the cardio-respiratory alteration, for most of the other physiological adaptations come about more leisurely.

The fetal circulatory system is a device which aims primarily to hold the normal respiratory function in abeyance,

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by means of a relatively simple shunting process. Beginning in the placenta, fetal blood, freshly oxygenated and laden with nutriment from the maternal circulation, enters the fetal organism through the umbilical vein, which then divides in two branches: (1) To the portal vein, which conducts the blood to the liver, whence it emerges through the hepatic vein, and so reaches the inferior vena cava; and (2) directly to the inferior vena cava through the ductus venosus. Joining then the venous blood from the superior vena cava, it enters the right auricle. Since the lungs are not functioning, only sufficient blood for their growth and nutrition passes through the ordinary path (tricuspid valve, right ventricle, pulmonary artery, lung capillaries, pulmonary vein and left auricle). Instead, it is largely deviated at two points: (1) Directly through the foramen ovale from the right into the left auricle, thence through the mitral valve, left ventricle and into the aorta; and (2) through the ductus arteriosus from the pulmonary artery direct to the aorta. Then, branching from the abdominal aorta, the internal iliac arteries give rise to the hypogastric branches, which carry a portion of the blood back through the umbilical arteries of the cord to the placenta for repeated interchange of nutritive and excrementious material.

With the beginning of extra-uterine life and the functioning of the lungs, certain of these structures are not only useless, but become detrimental if they persist. Five outstanding alterations normally occur: (1) The healed umbilicus is the only remnant of the cord and placental component; (2) the ductus venosus gradually closes and undergoes atrophy, while the umbilical vein remains visible as the round ligament of the liver; (3) the foramen ovale tends to close with the establishment of reduced pressure on the pulmonary side, and afterward gradually obliterates; (4) the ductus arteriosus is said to be closed by a valvular action in the wall of the aorta, followed by rapid diminution in its size, with final obliteration into a fibrous cord; (5) the hypogastric arteries

close down and ordinarily remain as sclerosed remnants throughout the life of the individual.

Failure of cardio-respiratory adaptation to extra-uterine life shows itself clinically in asphyxia, but in relatively few cases does the fault lie in any maldevelopment of the system. More frequently it represents a reaction to abnormal conditions of late pregnancy or labor. These may include: (*a*) Intra-uterine compression or twisting of the cord, knot formation, prolapse, rupture, and marginal insertion; (*b*) placenta previa or premature separation of the normally implanted placenta; or (*c*) tetanic contraction of the uterus, with ischemia of the placental site—each of which conditions exerts the purely mechanical effect of reducing the volume of circulatory interchange.

The fact that the ordinary contractions of labor do not induce fetal asphyxia has been ascribed to the fact: (1) That the placental site is relatively deficient in vigorously contracting muscular elements; (2) that a simultaneous vasodilatation takes place during muscular work; and (3) that the maternal blood-pressure rises sufficiently during labor to overcome any diminution in blood supply to the cells of the contracting uterus.

Likewise, profound maternal toxemias and uterine hemorrhage, as well as severe cardiac, renal or pulmonary disease, predispose to fetal distress.

From the side of the fetus itself: (*a*) Long-continued pressure on the cranial contents during the second stage of labor; or (*b*) actual trauma to the brain or meninges through excessive moulding or operative delivery will be similarly manifested by intra-uterine asphyxia. To these may be added the possibility of a disturbed balance between the maternal and fetal circulations after premature rupture of the membranes, particularly in combination with the prolonged labor that so frequently follows. Lastly, the aspiration of mucus or of amniotic fluid may produce asphyxia at birth, since excessive carbon dioxide may initiate respira-

tory movements *in utero*, and the sensory stimuli set up by the manipulations during an operative delivery may do likewise.

The diagnosis of impending fetal asphyxia is best made by the recognition of alterations in the fetal heart-beat. These signs are generally of practical value only in the second stage of labor, or the stage of increased pressure on the descending vertex. Alterations in the character of the fetal heart-beat will occur occasionally during normal pregnancy, and are apparently of no clinical significance; while such phenomena in the early stages of labor should not be viewed with anxiety, since undue efforts to hasten delivery at this point would in most cases, carry the operator far from the practice of conservative obstetrics. Obvious exceptions to this rule are the "hemorrhage" cases, which usually call for interference, while premature rupture of the membranes demands close observation of the fetal heart sounds because of the increased liability of cord compression.

A persistent alteration in the fetal heart-rate, with 100 and 160 as arbitrary limits, is probably the most satisfactory index of impending intra-uterine asphyxia. The *persistence* of this sign is emphasized because of the normal rate variations in relation to the uterine contractions. If, in addition to an alteration in rate, there is irregularity in rhythm, the situation becomes more urgent. A second sign, to which much importance is attributed consists in the antepartum passage of meconium in a vertex presentation, on the theory that profound asphyxia is associated with increased peristalsis, and with abolition of the reflexes controlling muscle tonus, wherein the anal sphincter is normally the last to succumb. Meconium is recognized by a discolored amniotic fluid, due to the presence of small particles of the material in suspension. The passage of meconium in concentrated form usually implies a breech presentation, and is without further significance. It should be added, however, that when meconium-stained fluid is associated with a normal fetal heart, as is

often the case, the situation may be best managed merely by increased vigilance and expectant treatment. The perception of violent fetal movements is an unreliable sign of impending asphyxia, and should be evaluated only in combination with the more classical signs.

At birth, fetal asphyxia is best recognized by the general appearance of the infant. *Asphyxia livida* (the "blue baby") is characterized by relatively good muscle tonus and a satisfactory slow pulse, the condition being usually attributable to a functional disorder which responds well to routine therapeutic measures. *Asphyxia pallida*, on the other hand, carries a much more dubious prognosis, for it is most often caused by serious organic trauma, particularly of the central nervous system. In addition to the generally "lifeless" reaction, with complete loss of muscle tonus, the respirations come in shallow gasps, if at all, and the slow and irregular apical heart-beat may be scarcely palpable, unless the vagus is paralyzed. Even the sphincters are relaxed, and there is markedly diminished cutaneous sensibility.

In contrast to both forms of asphyxia, the condition of apnea is sometimes encountered, which is a temporary cessation of breathing due to oxygen saturation. This is most commonly seen after elective Cæsarean section, when the normal placental balance is suddenly disturbed. True asphyxia results from oxygen deficiency, ultimately referable to an inadequate stimulation of the respiratory center with carbon dioxide.

Cardio-respiratory stimulation is the single goal of therapy. Mild degrees of new-born asphyxia require very little treatment, whereas the tendency, in the anxiety of the moment, is to overtreat the infant, at times to its detriment. Remembering that the situation occurs in connection with the most significant physiological changes, it naturally follows that *rest* will better insure a normal issue in this regard than the furious activity often instituted in the guise of therapy.

However, certain procedures are essential to proper treat-

ment: First, it is the attendant's obligation to create a clear air-way, for a degree of obstruction by mucus in the posterior pharynx is almost universally found. The practice of swabbing the infant's mouth with gauze on the finger results only in blunt dissection of the mucous membrane of the anterior half of the oral cavity, and doubtless favors the occurrence of mouth infections subsequently. In contrast to this practice, placing the gloved finger in the pharynx, and "snapping" it outward two or three times ordinarily suffices to clear the pharynx of mucus. A small curved aspirator, which can be placed as far down as the glottis, will effectively remove whatever is beyond safe limits for the finger. The catheter may serve similarly in an emergency, but it is clumsy, more difficult to apply and less effectual. The second principle of routine treatment is the matter of position. Aspiration of fluid and mucus is common, and its elimination is greatly facilitated by holding the child head downward, at the same time stroking the region of the larynx and trachea toward the oral cavity.

It is often stated that the contact of air with the skin furnishes the first stimulus to respiratory effort. Unfortunately, most writers specify *cold* air, and the error of this recommendation is manifest, when the instability of the thermal-regulating mechanism is recalled, and the necessity of conserving body heat in the new-born is appreciated. Tactile stimulation of the sensory surfaces is useful for overcoming mild asphyxia, but if gentle stroking along the course of the vertebræ, with the child held head downward, is insufficient to induce respirations, it is wisest to pursue another course.

Every operative delivery "set-up" should include a hot tub, with the water heated to 110° to 115° F. If fetal asphyxia persists after application of the above-mentioned maneuvers, the child's whole body below the neck should be promptly immersed. With the operator facing the child, it can both be supported in the tub and the accessory manipu-

lations can be executed. In this position artificial respiration can be maintained by pressing the anterior thoracic walls downward and inward with the two thumbs, while the fingers posteriorly serve to support the body and to resist the active movements of the thumbs. In common with all methods of artificial respiration, the greatest fault lies in attempting to fill and empty the lungs too frequently. Deliberate, thorough collapse and expansion of the chest, about twelve to fifteen times a minute, induces voluntary breathing much more readily than a more frequent rate. This routine gives the operator an opportunity to note the reaction to treatment between respiratory excursions, and at the same time allows constant palpation of the apex-beat of the heart. Alternating with this procedure, mouth-to-mouth insufflation can be practised without disturbing the position of the child and operator—and in this connection, it may be worth mentioning that both the mouth and nose of the child must be covered by the mouth of the operator, to insure filling of the lungs. Further technical points consist in: (1) The interpolation of a pad of sterile gauze between the two subjects, chiefly for the protection of the operator, in doubtful or outspoken luetic cases; (2) a slow and deliberate rhythm of insufflation; and (3) a reasonably short period of application, to avoid the possibility of dilating the stomach by the false passage or "overflow" of air into the esophagus.

Although the term "hot-and-cold tubs" has come into general use in this connection, it should be emphasized that the adjoining tub of ice-water should be regarded as purely accessory, and the less it is employed the better. Sudden immersion in cold water prior to the establishment of breathing constitutes a severe shock, and thus retards the process of resuscitation. On the other hand, the onset of regular breathing usually renders it unnecessary. In the occasional case regular shallow respirations can be expanded into a full-fledged cry by a single quick immersion, and immediate replacement in the warm tub. Likewise, a sudden spray of

cold water upon the face or thorax may furnish an excellent stimulus for crying, if applied at a judicious moment. In the absence of tubs, the same system of respiratory exchange can be maintained in a warm crib, or a second method can be employed, where the infant is held prone, with the two hands supporting the shoulders and buttocks respectively, and the back slightly hyperextended. The child is then gently "doubled-up" into the general shape of a hair-pin or in about the same position occupied in a frank breech presentation, thus collapsing the lungs mechanically by relaxation of the diaphragm and by outward thoracic pressure. This cycle is repeated at about the same rhythm as previously mentioned. In our experience these methods offer the greatest hope of success, with the least effort and danger to the child.

The Schultze method of swinging the new-born infant should never be used. Any advantages claimed for the procedure are so far outweighed by the obvious and the reputed dangers, that its employment should be condemned. Since many instances of asphyxia result from active hemorrhage, the all-necessary thrombosis is greatly delayed or entirely precluded by such vigorous manipulations. This, with the clinical reports of subsequent muscular injury, rib fracture, traumatic emphysema, pneumothorax and air embolism should justify discarding the method.

Pulmotors of various kinds have not proven superior to the methods of resuscitation described, but a supply of oxygen and of carbon dioxide or a combination tank containing 5 to 10 per cent carbon dioxide in oxygen is essential to a well-equipped hospital, and may be used to supplement any of the methods of artificial respiration described.

Much has been written and said concerning the efficacy of drug injection. Any physiological effect from such agents implies a normally functioning circulatory system, which is usually absent or far below its normal capacity in a case so urgent as to require them. This doubtless explains the

evolution of the recommendation over a period of some years: First, subcutaneous and intramuscular injection was advocated, then the intravenous route through the cord vessels, and lastly, into the cardiac muscle itself. Adrenalin and pituitrin are the products most frequently used. In our experience they have given disappointing results, possibly because they were applied too late. If drug treatment seems rational in the individual case, a useful stimulant is caffeine, in a dosage of $\frac{1}{4}$ gr. Another practice consists simply in allowing traces of aromatic ammonia to be inhaled from a gauze sponge in the course of artificial respiration. This may produce the most striking results, but if given in too concentrated form, may result in a temporary irritation and edema of the mucosa of the respiratory tract.

The proper interpretation of the infant's response to treatment is essential and is simple in principle. The apex-beat is the best index for the institution of treatment, its duration and its degree of success. If the heart-beat is definitely absent from the beginning there is practically no hope of accomplishing anything by the methods described. An early intracardiac injection of adrenalin may help in such a case, but it is rarely effective. On the contrary, so long as the apex-beat is palpable, no thought of relaxing one's efforts can be permitted, for such infants have been revived after long periods of continued trial. The strength and regularity of the pulse is, therefore, paramount, but the gradual deepening and more orderly rhythm of the breathing are easier to observe, and are almost as significant. The first loud cry is the signal of success, and only in the presence of organic damage will any recurrence of the clinical picture ensue.

The autopsy findings in asphyxia cases will generally show evidences of severe venous stasis, edema and congestion; small hemorrhages of a similar origin; and at times signs of aspiration into the bronchial tract. The more remote association of traumatic hemorrhage, atelectasis and congenital heart disease varies with the individual case.

When the new-born fails to respond adequately to the described course of treatment, and respirations remain shallow and irregular, or cyanosis persists, it is suggestive of underlying pathology, and calls for continued vigilance. The clinical picture is practically always that of deficient oxygenation of the blood, and it may be referable to one or more of the following lesions: (*a*) Atelectasis, or simple, incomplete expansion of the lungs, usually at the bases. (*b*) Congenital heart disease of any type which permits the admixture of venous and arterial blood, or which results in a diminished blood volume through the lesser circulation. (*c*) Cerebral hemorrhage, with involvement of the vital centers of the medulla. (*d*) Enlarged thymus, preventing adequate pulmonary expansion. (*e*) Diaphragmatic hernia, with the escape of the intestines into the pleural cavity. (*f*) Stenosis or obstruction in the respiratory tract.

Each of these conditions is later discussed in its place, but here it suffices to say that the rational course to pursue is: (*a*) The establishment of the diagnosis; (*b*) repeated tubbing, as indicated; and (*c*) administration of oxygen and carbon dioxide when necessary, by nasal catheter.

Following the establishment of respiration, a preliminary cleansing of the skin is important. Vernix caseosa is insoluble in water, but is readily removed by oily fluids, and the present routine of bathing the entire body with sterile olive oil or mineral oil on gauze sponges is the outgrowth of the old practice of first "bathing" the child with lard, but it possesses the advantages of cleanliness, accessibility of the skin folds and easier subsequent removal. Another useful function of the initial oily application lies in its relative heat-preserving effect, in contrast to the action of water or other more volatile fluids. Lastly, a rather vigorous massage of the skin does no harm, and usually induces a satisfactory crying spell, which effects a thorough expansion of the upper bronchioles, although complete pulmonary expansion does not ordinarily ensue until about the third day.

The tradition that one should wait for complete cessation of pulsation in the cord before its ligation, upon the theory that the infant gains a larger blood volume thereby, has been exploded by experiment. Furthermore, the new-born is a plethoric individual, who normally tends to destroy some of its own blood in the first week of life, to the point of showing hemolytic icterus. The cord tie should always be of sterile material, preferably of "bobbin" for a combination of strength and non-cutting effect, and tied with a square knot—twice, at points about 1 cm. apart, leaving 3 or 4 cm. of cord proximal to the ligatures for a retie, in the occasional instance where retraction and oozing from the original ligature ensues. The muscular layers of the umbilical arteries contract very efficiently in the normal child, and the pressure reduction effected by the functioning of the lesser circulation ordinarily favors prompt thrombosis, while any of the lesions which predispose to cyanosis tend to favor recurrent bleeding from the cord.

The cord dressing calls for a product possessing two qualities, (*a*) surgical cleanliness, and (*b*) a desiccating effect, both of which are best secured by 95 per cent alcohol. As to its application, the usual recommendation that the cord be done up like a "sore thumb" results in a knot of material which promotes neither comfort nor a healthy involution. A flat dressing can be made by drawing the cord through a small hole cut in the center of a gauze square and then folding in the four corners. This is held in place by a lightly applied woolen binder, secured with very small safety pins on the *side* of the body. The dressing need be changed only as it becomes soiled, and the less it is manipulated, the better. Treatment of the cord by a surgically clean technique has been one of the great contributing factors in the reduction of infant mortality.

In many states the law requires that the eyes of the new-born must be protected by the instillation of 1 per cent silver nitrate or its equivalent in the organic silver com-

pounds, without regard to any related factors, social or otherwise; but it might be emphasized here that nothing has wholly replaced the nitrate of silver in efficacy, accessibility, economy and universal recognition as an adequate agent. However, this simple prophylactic measure is a two-edged sword in two respects: (1) If *dropped* upon the cornea from any height, be it ever so little, mechanical trauma, with subsequent opacity, may follow; (2) if the medication is not washed out subsequently, the treatment itself produces a disagreeable non-specific ophthalmia in a number of cases. Hence, the routine procedure to be recommended is: (1) To draw down the lower lid and to place a drop of 1 per cent $AgNO_3$ in the conjunctival sac, followed by a few seconds' wait, to allow the medication to permeate all parts of the bulbar and palpebral conjunctiva, after which (2) gentle irrigation of the sac with warm 2 per cent boric acid is carried out. Physiological saline is less satisfactory for this purpose, since the chloride reacts with the silver to form an insoluble precipitate, thus rendering inert whatever soluble silver has escaped the chlorides in the lacrymal secretion. Ophthalmic inflammations coming on the first day or two of life, however, cannot be regarded lightly, for, although they ordinarily signify a reaction to treatment, yet they may portend a virulent specific infection.

The one figure of universal obstetrical interest is the child's weight. The use of the metric system and a balanced scale, with readings corrected for clothing and dressings, are essential to correct records; but if the weight is expressed in terms of pounds alone, a sufficiently accurate approximation can be obtained by the utilization of the ordinary spring scale, in *lieu* of the weight-sense of the outstretched arm, which accounts for so many excessive-sized babies described in all good faith by many parents.

Other measurements are of less importance in the average case, but when it is recalled that the whole process of labor is largely a matter of the adaptation of a particular head to

a particular pelvis, and that the science of pelvimetry is recognized as basic in all obstetrical work, the rationale of studying the normal head is apparent. Detailed figures in this regard would carry this work far afield, but it can easily be recalled that the biparietal diameter of the head is comparable in fundamental importance to the antero-posterior diameter of the pelvic inlet, or to the bituberal measurement of the pelvic outlet, and that it normally measures about $9\frac{1}{2}$ cm. The knowledge of this measurement, in itself, may serve as a check, postoperatively, for the justification of a Cæsarean section that has been performed on a pelvic indication; but a consideration of the relation of the size of the cranial diameters to various complications of labor is redundant at this point.

CHAPTER II.

THE PHYSIOLOGY AND DEVELOPMENT OF THE NEW-BORN.

The average full-term male infant weighs at birth about 3250 gm. ($7\frac{1}{4}$ pounds) and the new-born weighing 4000 gm. and above can be properly classified as excessive in size and often responsible for fetal dystocia. Infants of 9 to 10 pounds are not uncommon, but beyond this figure authentic instances become progressively fewer. In one clinic the largest infant among some 25,000 cases weighed 6100 gm. ($13\frac{1}{2}$ pounds). Female children and the infants of negroes are, on the average, somewhat smaller. 2500 gm. is generally accepted as the low limit of maturity; and 1500 gm., of prematurity. For statistical purposes everything below the latter figure is designated as an abortion in spite of the occasional instance of survival. Full-term length is about 50 cm. (20 inches), but where greater accuracy is essential the crown-rump or sitting-height measurement is utilized. The length of the aborted fetus furnishes a convenient index of its age in lunar months, which is approximately the square root of the length in centimeters, up to the sixth month. From this time onward, the length divided by 5 gives the age in lunar months.

The weight of the new-born is quite characteristically distributed and is centered chiefly in the head and abdomen. The latter preponderance is partially accounted for by a relatively large and heavy liver, one function of which is that of storing iron to tide over the first few months in which this element of the diet is notably deficient.

The most reliable index of the general well-being of the

new-born is the weight curve, but its proper interpretation depends upon a knowledge of the normal course and the physiological variations. Generally, the new-born will suffer an initial loss of about 10 per cent of its birth weight during the first few days, due largely to the escape of water in the meconium, urine, expired breath, vomitus and through surface evaporation. This is not ordinarily compensated by an adequate milk intake in the first two or three days of life, as is the case thereafter. Hence, the administration of water is indicated during the days immediately following birth and thereafter, as will be repeatedly emphasized. This loss is likely to be relatively larger: (*a*) In the children of primiparæ; (*b*) in infants of excessive birth weight; and (*c*) in cases of delayed lactation.

This feature of infant physiology has prompted some observers to employ various devices for preventing the initial weight loss, at least, in part. Actually, the only constitutional reaction ordinarily observed is the occasional occurrence of an associated fever, formerly attributed to inanition, but more properly called *dehydration fever*. The administration of about 1 ounce of warm boiled water every four hours acts as a specific against the occurrence of this type of fever and, to some extent, against the weight loss. The early use of artificial feeding and allied procedures is rarely successful in driving the weight curve upward by main force, and it is well known that the behavior of the weight in the first four days is no index of its subsequent character. We repeat here the former dictum that the organism is in a period of adjustment, and is not a good subject for experiment.

Proponents of forced feeding imply that the case presents the appearance of a failure if the birth weight is not regained by the time the child ceases to be an obstetrical problem, let us say, by the tenth day. This, we believe, is fallacious reasoning, for the actual weight of the child in grams on a selected day is relatively immaterial in comparison to its *weight tendency*. If the weight curve runs in the right

direction, if the child shows a proper reaction to its feedings, and if the environment is correct, with an intelligent mother or nurse in charge, the number of grams gained daily is of secondary importance.

The normal weight curve of a nursing child should become stationary or show a slight gain about the third or fourth day, and from that point should show an upward tendency at a rate which varies with the individual metabolic "habit" of the child, the quantity of food (rarely, if ever, the quality in breast-fed infants), the general degree of nursing success and the child's ability to utilize what it obtains. Normally, the curve is a zig-zag line whose apices move in a generally upward trend. In hospital practice daily weight records are essential, but bi-weekly weighings at home when the net result is likely to show a gain are best recommended to the patient; otherwise the mother is likely to be rendered needlessly anxious on the days when the child stops to "catch its breath." The most accurate weights are obtained if they are recorded at a certain hour of the day, under constant conditions relative to meals, clothing and the like. Although considerable variations will occur and still be considered normal, a gain of 4 to 6 ounces (120 to 180 gm.) a week up to about five months is the rule, resulting in a doubling of the birth weight at this time, after which the gain is somewhat slower, reaching a figure of about three times the birth weight at twelve to fifteen months.

The body temperature at birth is ordinarily a little above the normal figure, but its subsequent instability is most characteristic, and the analogy between the very young infant and a cold-blooded animal is largely true. This tendency calls for the application of external heat from the time of delivery, and the practice in some hospitals of utilizing an electrically warmed crib in the delivery room is admirable. However, excessive heat may send the body temperature to great heights, and such occurrences are often referable solely to close proximity to a hot radiator, for example. The skin

doubtless furnishes a second variable which adapts itself slowly to the function of temperature regulation in coördination with the brain center.

The child usually reacts vigorously to the ordinary fever-producing stimuli, which are primarily dehydration and infection. Thus, in the presence of sudden or continued fever, the normal procedure is: (1) The removal of external heat-producing stimuli; (2) a search for foci of infection; and (3) giving increased amounts of water, which is sufficient in the great majority of cases to restore normal conditions. The important point is *not* to overlook early infectious foci, although the increase of fluids is here indicated quite as strongly. It is likewise established that, whereas the commonest period of dehydration is from the second to the fourth day, yet it can and does occur later in many instances. When fever reaches excessive heights from any cause, tissue damage can doubtless be reduced by the use of tepid sponges, as in adult therapy.

The ordinary dehydration fever of the first week usually comes and goes rather suddenly, and is of the remittent or intermittent type. Lethargy and anorexia more frequently attend the picture than any demonstrable evidence of pain or pathological tissue change.

The apex-beat in the new-born is normally palpable in the third interspace just outside the nipple line, which location is attributed to the equality in the transverse and antero-posterior thoracic dimensions in combination with a relatively high position of the diaphragm, all tending to produce a more horizontal cardiac axis. The first sound predominates over the whole precordium. The pulse is extremely variable, presumably due to the imperfect development of the regulating center in the medulla, but it averages about 140 per minute at birth, dropping to around 100 by the third week. Arrhythmias are fairly uncommon and do not run to type. The average blood-pressure of about 60 mm. at birth rises to a fairly constant level of 80 mm. during the first week, but

blood-pressure readings are of little practical value in the interpretation of the common disorders of infancy.

The respiratory-rate at first averages about 50 per minute, and is necessarily shallow; but the rate is reduced as the period of partial atelectasis ceases, and the increased air requirement is met by a deeper type of breathing. Irregularities of rate are commonly seen. The mechanism is essentially diaphragmatic, and is normally smooth and quiet, persistent dyspnea being of pathological significance.

The hemoglobin at birth averages well over 100, coming to normal (80 to 90) at the second or third week. The red cell counts run similarly high, from 5,000,000 to 8,000,000, and fall to an average of 4,500,000 to 5,000,000 along with the drop in hemoglobin. In jaundiced infants both readings are relatively low. Leukocytosis in the new-born is likewise a constant finding, but the normal figure is variously quoted between 12,000 and 35,000. This falls to about 8000 along with the reduction in the red elements, and it is well established that in the course of regression an original excess of polymorphonuclear leukocytes gradually gives way to a decided lymphocytosis. The influence of concentration as a causative factor in the production of the alterations of blood count is suggested by the parallel variations in specific gravity, but other factors of a more subtle nature doubtless contribute. Studies upon many other blood constituents are available, but the data are not essential in routine practice.

An infant delivered *per vaginam* is likely to show bizarre changes in the head tissues, particularly if the labor has been prolonged or the head has undergone excessive adaptation to the bony pelvis. *Moulding* of the flat bones of the cranium is permitted by their relatively loose-jointed connections at the suture lines—a natural mechanism of greatest obstetrical import which renders many potentially operative labors spontaneous, and only constitutes a liability in the occasional case where the area is a point of least resistance between very forcible uterine contractions and an unyielding passage,

resulting in vascular damage. An average amount of moulding should undergo spontaneous correction in about a week. The general outlines of a freshly moulded head serve in part to confirm the position within the pelvis during labor. Permanent changes in skull configuration are thought to be preformed in the uterus, and are often the cause rather than the result of malposition in labor. *Caput succadaneum* is the term used to designate pressure edema of the presenting part, usually of the scalp, and although this condition is more properly classified as a birth injury, it is sufficiently common to mention here as a physiological entity. This alteration, however, in conjunction with moulding, makes accurate measurement of the head quite impossible at times, so that the figures obtained are significant only in so far as they relate to the pelvis which the head has just traversed. The same is true of *cephalhematoma* which is likewise discussed later in detail.

The *fontanelles* are usually classified as anterior and posterior, the so-called sagittal fontanelle between being of lesser significance. The posterior, or small triangular defect between the occipital and parietal bones, normally closes in six or eight weeks, although it is often closed at birth. After mentioning its association with the problems of diagnosis of position in labor, it has no further clinical significance. The anterior, or large diamond-shaped fontanelle, is located at the junction of the two parietal and two frontal bones, and ordinarily persists until the eighteenth or twentieth month of life. It may serve to suggest early nutritive and developmental disorders by the occasional delay in closure, but it should be added that an elongation of the sagittal suture to the root of the nose may be seen in the absence of any underlying pathology. An increase of tension, or an actual bulging, sometimes aids in the recognition of increased intracranial pressure.

Occasionally a child is born with erupted incisor teeth, but beyond the possible deleterious effect upon nursing, the fact

is not important. Not infrequently, however, the first appearance of teeth antedates by several weeks the customary time of about six months.

The new-born is essentially a "spinal" (or "sub-cortical") animal, endowed with only the most fundamental reflexes, but the unmistakable evidences of *emotion* from the onset signify a functioning cerebrum. Of the tactile reflexes, the most perfectly developed is the sucking reaction, and thumb-sucking is very often seen almost instantly after birth. The grasping reflex is likewise highly developed, but is somewhat more variable with the individual. Generally speaking, the further the new-born is removed from full-term development, the less perfect are these instinctive reactions. In many instances of prematurity the swallowing reflex is totally absent and gavage becomes a necessary procedure.

Pain sense, both peripheral and visceral, is manifestly present from birth, but is diffuse and probably much less intense than in later infancy. Observations upon the nervous functions of the new-born are not in general accord, probably due to variable degrees of myelination, peripheral acuity and muscle tonus. The commoner reflexes are ordinarily demonstrable as follows: (*a*) Knee-jerk, usually present from the first day. (*b*) Ankle-jerk, variable; quoted as high as 60 per cent. (*c*) Babinski, positive in the majority of cases. (*d*) Cremaster, same. (*e*) Abdominal, ordinarily present. (*f*) Pharyngeal, present in term infants.

Among the special senses, that of taste is best developed. Accurate discrimination is evident between pleasurable and unpleasant stimuli in fluids of reasonably strong concentration.

The eyes of the new-born are almost universally of a slaty blue-gray in color, and do not take on their individual pigmentation until about the third month, except in unusual instances, where the color is determined from birth. In early infancy vision in the usual sense is lacking, although a source of light will generally attract the eyes toward it, by the pleas-

urable sensation induced; or it may cause their closure, through the defense reflex. The pupillary reaction appears to an extent compatible with the neuro-muscular strength. In the majority of instances coördination is very imperfect, so that in almost all cases there will be seen at times a certain degree of strabismus.

The auditory reflex functions in a crude way as soon as the canal is mechanically opened and adequate air is admitted to the tympanic cavity in the course of the first respirations. Loud or shrill noise provokes a response from the first day, due to the general "pain" perception. However, the recognition of sounds, as such, or any discrimination between them, is not developed until about the third month.

The mechanism of digestion in the new-born does not differ radically from that of the adult, except in so far as it is accommodated to a single article of diet. For this function, however, it is well equipped.

Milk digestion begins in the mouth, where the *ptyalin* of the saliva starts the process of carbohydrate splitting, along with the lesser effects of slight dilution, and a minute amount of coagulation.

The stomach secretes *rennin,* the specific effect of which is to precipitate the casein into curd, *pepsin,* which splits the proteins into albumoses and peptones; and *lipase,* by which about 25 per cent of the ingested fat is converted to glycerin and fatty acids. The ptyalin probably continues to act in some degree, and the simple sugar so produced, some of the salts, and a fraction of the end-products of protein are here absorbed. The unchanged fats and proteins remain longest in the stomach—about two to three hours—and in the interval, the whey and the partly digested curd slowly pass the pylorus.

Hydrochloric acid is abundantly secreted by the new-born, and converts protein to the acid-albumins, which are more easily digested, particularly in a human milk diet, but the acid is more quickly "bound" by cow's milk because of its

higher protein and salt fractions. The stomach capacity at birth is about 2 ounces, but larger feedings are utilized, partly because of the ready escape of the water from the pylorus.

The small intestine is the important focus of digestion in the new-born, and this is largely accomplished by the pancreatic *trypsin* and the *erepsin* of the duodenal mucosa, both of which convert the proteins to amino-acids, whereupon they are directly absorbed. The remaining sugars are split to monosaccharides by *lactase* and *invertase,* and here utilized, while the fats are further hydrolyzed as before (*lipase*) and taken up by the intestinal mucosa, where they are reassembled as fat molecules and distributed, deposited or oxidized. That which is not utilized in the intestinal tract is eliminated as neutral fat, fatty acid or soaps. A trace of the starch-splitting enzyme, *diastase,* has been demonstrated, but clinically, the new-born can only tolerate the simplest polysaccharides in dilute solution. Digestion is completed in the small intestine, and the liver forms glycogen and urea in the manner characteristic of the adult. With this equipment it might appear that the infant's digestive capacity was reasonably adequate, but in practice anything more than an essential milk diet is poorly tolerated.

The colon serves mainly to absorb water and to excrete salts, but it has no importance from the standpoint of enzyme production.

Fundamental metabolic facts are directly applicable to the new-born organism in so far as the carbohydrate is largely the energy-producing factor, through its hydrolysis to carbon dioxide and water; and the protein end-products are the source of cellular maintenance, growth, replacement and, to a small extent, supplementary to the carbohydrate dynamic action. The lipoids, particularly lecithin and cholesterin—an essential constituent of nerve tissue—are contained in the fat ingested, and this is an added warning against the prolonged use of fat-free milk. The salts form an indispensable element and appear to exist in the milk in optimum

proportions. Their most important chemical action lies in their soap-forming function in the small intestine; and metabolically, they are a primary cell constituent, furnishing building materials for all cells, particularly nerve and muscle, while their presence is indispensable to the water exchanges which are most fundamental in the infant's metabolism. The water requirement in the first month of life is about one-fifth of the body weight, daily, in contrast to one-eighth at the end of the first year and about one-twentieth in adult life.

Vitamin intake is abundantly provided for in the new-born. Whereas we are inclined to associate the fat-soluble A primarily with cod-liver oil, egg-yolk and plant leaves; water-soluble B with yeasts and grain embryos; and water-soluble C with citrus fruits and green vegetables, yet milk contains all of these in small quantities, which fact further proclaims its great food value.

The transition from the pasty, black, odorless, meconium stool through the stages of black-green, green-brown and brown-yellow ordinarily requires about seventy-two to ninety-six hours, after which the normal yellow breast milk stools are established. The latter are largely composed of food remnants, epithelial cells, crystals, mucus, fat, fatty acids, soaps, intestinal secretions and bacteria. The yellow breast milk stool has a characteristic sour odor, is semi-formed and contains flaky, finely divided curds, while the color is due to the contained bile pigments. An excessive protein intake favors putrefactive changes through the alkaline medium created, and the *colon bacillus* predominates. This tendency is most marked in bottle-fed infants, in whom the stools are firmer and drier, less frequent, pale yellow in color and of a foul odor. An increase of carbohydrate conduces to acid fermentation where the predominating organism is the *Bacillus bifidus*. This condition prevails in the breast-fed infant where the normal stool is acid and of a sour odor, rich in fatty acids and soaps. In addition to the predomi-

nating organisms mentioned, Bacillus acidophilus and Bacillus lactis aërogenes are constantly present after the fifth day. The frequency of bowel action in the new-born is about three to four times daily, in the average case.

The urine at birth often shows albumin, probably of "congestive" origin, and uric acid in increased amounts, but the infant should quickly become albumin-free, with occasional recurrence, in association with nutritional disorders. After the third day the new-born child voids ten to fifteen times a a day, and the amount represents 45 to 70 per cent of the fluid intake. The total amount varies with the intake of fluid, the weight and the kidney threshold for the individual. The amount voided in the first three days is quite variable, averaging about 60 cc. daily, but a temporary suppression is not infrequent. Faulty observation accounts for some cases of "retention." The normal infant urine is clear, of low specific gravity (1003–4) and of a pale yellow color, except in the brief period of weight loss, when the concentration rises and a cloudy precipitate of urates occasionally appears. The reaction is normally acid.

Retraction of the foreskin at delivery is not essential to successful bladder function, and when so practised, often hurriedly, it may do harm.

At the sixth week of intra-uterine life the fetus is over 97 per cent water, which figure drops to 71 per cent at term, contrasted with 58 per cent in the adult. The salt content after the fourth month is stationary at about 2.7 per cent, with the exception of the calcium factor, which gradually increases up to full-term, as is true of the iron. Similarly, the study of salt metabolism in early infancy has shown the highest retention index for calcium and phosphorus. The demands for skeletal growth are thus provided for in both intra- and extra-uterine existence.

The cartilaginous nature of the skeleton at birth, and the hypermobility of the joints, permit an unusual degree of

flexibility. The dorsum of the foot, for example, is easily applied to the anterior surface of the lower leg—a fact utilized in differentiating the normal from a congenital club-foot; while the child can actually be appreciably elongated by traction, due to the unusual flexibility or elasticity of the elements of the vertebral column. On the other hand, knowledge of this tendency is essential in the proper handling of the child, in the matter of adequate support for the head upon lifting the body, for example, since the muscular strength is relatively insufficient in very early life, not only for active use but for the more passive function of protecting the fragile structures beneath.

The skin of the new-born is of delicate texture and is easily irritated, traumatized and infected. The color is fairly constant in the normal, well-developed infant, and it is distinctly a pinkish-red, which bleaches out in a few days, but shows very little variation at first with its racial origin. The problem of recognizing negro parentage in the new-born often can be solved only by noting the characteristic increase of pigmentation in the nail beds and the genitalia. The assumption of generalized pigmentation of the skin is notably variable. Lastly, despite all popular reports to the contrary, no laboratory test has been devised which assists in any way in this and similar problems.

In the first week of life practically all infants show a certain degree of peeling of the epidermis. This may be so generalized as to present an alarming picture to the uninitiated, but it is a self-limited condition, and is evidently without significance. It appears to be little influenced by dietary considerations or by an increased fluid intake.

The question of icterus neonatorum, although frequent enough to be considered physiological, is sufficiently often a symptom of disease to warrant its discussion later under Disorders of the Skin.

In the new-born a full growth of hair or any variation, as

far as complete baldness, is accepted as normal, while the eyebrows and the lashes are usually poorly developed. The initial color of the hair ordinarily persists to maturity. The *lanugo*, or fine silk-like hairs which covered the body at one stage of intra-uterine development occasionally persists after birth, usually in a patchy distribution, or even localized to one area. This is without significance, and it is usually lost within a few days.

Similarly, there is considerable variation in the development and functional behavior of the glandular system. The glands of the gastro-intestinal tract are ready to function at six months *in utero* and thereafter, but their secretions are largely held in abeyance until food is ingested. On the other hand the lacrymal glands take up their function more deliberately, and the result is an increased tendency to infection of the eye, with the attendant necessity of keeping them clean as a factor in proper nursing care. Just as the lacrymal function is retarded, perspiration is also inadequate, again necessitating the external regulation of temperature. This function improves within the first few weeks, but if excessive, or "precocious," is suggestive of early rickets, and warrants further study along those lines.

The new-born, regardless of sex, shows in most cases distention of the breasts with milk, which is chemically identical with colostrum. This reaction is thought to be a hormone effect attributable to the influence of the *mature* placenta, since it is rarely seen in premature infants. The congestion appears at about the fourth to sixth day, reaches a maximum about the tenth day and disappears spontaneously within the first month. Treatment is practically never necessary. The occasional complication of mastitis or of breast abscess usually means that some one has attempted massage or some similarly contraindicated procedure. Cellulitis should rarely be confused with simple engorgement, since the infectious lesion is usually unilateral.

Pseudo-menstruation is occasionally seen in female infants, coming on about the fifth day and lasting two to three days. This is attributable to a temporary imbalance in the endocrine system, wherein the pelvic viscera undergo a transient hyperemia. Rarely, if ever, will the bleeding assume alarming proportions, except as it may be a symptom of a hemorrhagic diathesis. Phimosis in the male is properly a physiological condition, and its occurrence has called forth more discussion than the condition warrants. In present-day practice far more local inflammations are caused by forcible retractions than would ever occur with expectant treatment.

Under a strictly aseptic routine, such as that described, the stump of the umbilical cord runs a fairly constant course. Discoloration and shrinkage make their appearance in a few hours, and the thrombosed vessels become more easily visible within the stroma of the cord. Externally, small areas of ecchymosis are seen. At the base a circular red line appears after the first day, representing the area of subsequent separation. With increased desiccation, producing eventually a hard tortuous string of tissue, a steady alteration in color toward a brownish-black, plus a progressive obliteration of the vessels, the slough finally occurs, leaving a granulating surface, which scars over in a few days.

With the ordinary feeding schedule, the new-born will, and should, sleep about twenty hours out of the twenty-four, gradually reducing this amount with the development of the special senses. Following the period when the life of the infant is solely a composite of reflex activities, the eyes probably first assume their specific functions, with improved coördination and evidences of light perception. Hearing becomes an independent reflex in a general way by the third month, after which the perception of odors and finer discriminations of taste appear; and by the sixth month the first beginnings of simple intellectual processes are evident.

A normal child will hold the head up for short periods by

the second month, sit erect at the fourth month, and first react to lights and noises about this time. At five to six months the child should articulate vowels and attempt creeping, while "walking and talking" rarely are accomplished before the tenth.

Interpretation of the infant's general condition is a purely objective problem. The weight, the color, the condition of the flesh and the character of the sleeping hours, coupled with the individual reaction to feedings, are the best indices of proper development.

CHAPTER III.

THE NURSING CARE OF THE NORMAL INFANT.

Of the large number of children who survive the liabilities of the prenatal and intrapartum periods, it is said that 4 per cent die within the first month of life and about 8.5 per cent during the first year. In this country alone the number of such deaths each year amounts to about 100,000 and 200,000 respectively. A consideration of requisite care in the first month of life is, therefore, highly pertinent, for this factor alone regulates the outcome in a large measure, and is one of the most practical phases of preventive medicine. It should, however, be remembered that a certain proportion of the deaths occuring during the first month are referable to congenital abnormalities, and therefore are susceptible to little or no improvement.

The care of the normal infant is largely directed against two outstanding dangers, disorders of nutrition and intercurrent infections. Although not as applicable to the newborn as to the older infant, the basic fact remains that respiratory infections are commonest in the winter months, while gastro-intestinal disorders are more peculiar to the hot seasons.

The most important single contribution to successful infant care is proper feeding, and the subject is sufficiently extensive to warrant separate consideration later.

Frequent regular bathing is a fundamental necessity in infant care, apart from all other considerations. Oil baths are indicated first of all for the complete removal of the vernix; likewise where the skin manifests an undue tendency to irritability or shows a lesion already in progress; and,

finally, for premature infants, both for the heat-preserving qualities of the oil in contrast to water and as a protection to the excessively delicate epidermis.

Soap and water may be employed practically from the beginning, but sponge bathing should be carried out until the cord has dropped off and the umbilicus has healed, after which the tub bath is preferable. In sponge bathing it is important to treat one part of the body, such as the scalp, face and neck, at a time, with immediate drying. This may be carried out on a table somewhat more rapidly than in the lap, but in the latter method there is, perhaps, less liability to injury; and its intimacy seems to make an appeal to the average mother, whereby the time element is discounted.

In either event, the air of the room should be reasonably warm (72° to 80° F.) and free from draughts. The bath water should be maintained at about 100° F. and a tepid supply at 85° F., determined by the thermometer in every instance. Flushing the skin with the cooler water at the conclusion of the bathing depends upon the child's individual reaction, and is by no means essential. Pure Castile or a liquid green soap should be chosen for routine employment. Towels and blankets should be kept warm until called for, and the same applies to the garments to be applied at the conclusion of the bath.

The eyes of the new-born should be gently irrigated once a day with warm sterilized 2 per cent boric acid solution until the lacrymal secretion is established. Boric acid is recommended not so much for any specific bactericidal value as for the assurance of using a solution which is reasonably clean. Trauma to the cornea may result from this procedure, and the method is recommended more to the well-trained and conscientious nurse than to the average mother, who might better limit the care of the eyes to a bi-daily external cleansing with fresh boiled water.

The nasal passages call for gentle swabbing with mineral oil applied by a small cotton applicator, or pointed pledget,

or even by a dropper (preferably rubber-tipped). This keeps the secretions soft and non-irritating, maintains a free airway which promotes nasal breathing, and acts prophylactically against upper respiratory infections. Care should be taken, however, to avoid applying the fluid under pressure, because of the patency of the Eustachian tubes and the coincident liability of middle-ear infection.

The auditory canal is best let alone in routine nursery care, and cleansing with small oil pledgets limited to the external parts only.

The mouth is not touched in the course of routine nursery care. Gentle pressure to the cheeks between the jaws opens the latter sufficiently for routine inspection, when the normal pink mucosa is usually found to be covered with milk curds.

During the first twelve hours the cord should be inspected frequently for bleeding. Such an accident is easily controlled by a fresh ligature placed proximal to the first; but hemorrhage from either the cord or umbilicus at a later period suggests hemorrhagic disease, calling for accessory diagnostic and therapeutic procedures (q. v.).

The cord dressing is reapplied only as it becomes soiled, and then as described heretofore, but the stump may be inspected daily beneath the dressing to observe the rapidity of involution and to note any beginning infection at the umbilicus, which will be manifested by the usual signs of redness, swelling and tenderness in association with a febrile reaction. Lastly, the stump of the cord should be allowed to drop off spontaneously, as efforts to remove it prematurely may result in unexpected degrees of bleeding. The application of an alcohol sponge to the granulating umbilicus is good practice.

The foreskin in the male infant should be treated very conservatively in most instances. The tiniest opening suffices for the escape of urine, and the tendency to the accumulation of secretory products beneath is not marked. However, it is best that the parts be made as nearly normal as possible

during the period of medical oversight, rather than to leave the matter to less skilled attendants. The foreskin is ordinarily retracted with ease, and occasional cleansing of the glans with oil or green soap suffices thereafter. When it is adherent retraction should be attempted over several successive days until it is gradually but completely effected, thereby causing minimal trauma. If the foreskin resists all attempts at retraction circumcision is recommended, but need not be urged if the parents prefer to adopt an expectant attitude. On the other hand, the operation can be safely performed without danger to the child, whenever it is really indicated. A preliminary determination of the bleeding- and clotting-time is good practice. The dorsal slit operation is a feeble compromise and is not recommended except in the occasional instance of unreducible paraphimosis. In this connection it should be added that after every retraction of the foreskin its replacement should be initiated with a certain "snapping" sensation, signifying that the glans has slipped back beneath the ring of fibrous tissue at its base.

In female infants the labia should be cleansed daily with oil, applied upon soft pledgets. The trifling significance of vaginal bleeding has been mentioned, but any appearance of pus at the outlet demands bacteriological study, since specific vaginitis in the new-born demands early treatment.

The importance of keeping the child dry is so trite a matter that it is mentioned only for the sake of completeness. However, this simple practice predisposes to healthful sleep, and aids greatly in the prevention of local skin pathology.

A clean and well-dried skin requires no further treatment except in the folds about the buttocks and genitals, where a thin coating of oil prevents irritation. Water should be used upon the body only during the bath. The cleansing necessary when "changing" the baby is better done with cotton and oil as described. However, the employment of powders is so universal that their use deserves mention: There is

no objection to the proper use of a well-chosen powder. It should be kept in a broad, flat dish and should be lightly applied with a puff, leaving a very thin layer, which gives to the skin a grayish appearance. Excessive amounts are irritating. The vegetable and talcum powders excel in general efficacy those with a pure mineral base, such as stearate of zinc. The latter is an actual menace in the nursery, because of the occasional instance of its inhalation, where the zinc combines with the nitrogenous secretions of the respiratory mucosa to form the insoluble zinc albuminate. Either the actual precipitate or the edema set up has caused suffocation and death in several authentic instances.

The daily weight is best recorded at the conclusion of the bath and under conditions of reasonable uniformity as regards feeding and clothing.

The quality of the garments of the new-born should be adjusted to the season and to the temperature. Essential requisites are fulfilled when they are as light as is compatible with adequate warmth. They should be soft, porous and loosely applied. Coat shirts which button at the front are handled conveniently and are most comfortable for the child. Stockings are not essential and are little used in well-ordered nurseries, as warm water bottles at the foot of the crib are more efficient. Overdressing the infant predisposes to skin irritability, digestive disorder, restlessness and susceptibility to infection. Strict cleanliness is again emphasized, particularly as regards the diapers, which are best made of birds-eye cotton in such widths as to suit the individual case. Their application may be made by any method that does not concentrate the bulk of the material in such a way that the infant is forced to lie continually with the legs hyperabducted. This is best accomplished by applying them "square" in preference to the triangular folding. This eliminates loose corners that might irritate, places the soiled spot on a portion of the cloth easiest to wash and allows a more unrestricted motion of the legs. Abdominal bands are of no value other

than to hold the cord dressing *in situ*, so that after healing of the umbilicus they are better dispensed with.

The degree of nursery ventilation recommended varies with the weather conditions and the constitution of the child, but, generally, every opportunity to breathe fresh air should be encouraged. In addition to periodic airing of the nursery, and the employment of devices for its continuous ventilation, periods of sleep out-of-doors are recommended, during which precautions should be taken to insure adequate warmth and to shield the child from wind and strong light. The optimum temperature for the nursery has been found to be about 72° F. during the day and 65° F. at night.

The first weeks of life are of such a passive nature that the only real exercise practised is that of crying. The latter is a physiological necessity and should be induced several times a day. At definite, but not too frequent intervals, passive movements should be carried out by the attendant, encouraging muscular activity, such as grasping, and other active movements of the muscles of the extremities. The orthopedic surgeon has shown what can be accomplished with the use of properly directed exercises in the treatment of birth injuries, which have affected the voluntary muscles. The benefits of exercise are also enhanced by an intelligent technique in carrying the child. Up to the third or fourth month the head should always be supported in lifting and carrying, but, further than this, the attitude and position of the child should be varied constantly to encourage symmetrical muscular activity and growth.

Regularity of habit in the new-born can be largely influenced by proper oversight, and the most important contributing factor toward this goal is the practice of combining the essential activities in regular sequence. Thus, it has been found advisable to follow the routine morning bath with a recording of the weight, after which comes the regular feeding. Similarly, the logical time for exercise of the mus-

cles and stimulation of the rudimentary psyche is in the evening before the regular feeding hour, and preparatory to a relatively longer sleeping period.

In early infancy much can be accomplished in regularity of bowel action by stroking the abdomen along the course of the colon for a brief period, at a definite time in the day's schedule; while persistent efforts to induce bowel action by supporting the infant over a small chamber at regular intervals are often effectual. The normal breast-fed child should not be constipated, but when this condition arises the treatment is simple, as will be outlined later.

The matter of thumb-and fist-sucking soon changes from a simple reflex into a habit, and its value as an index of hunger is far outweighed by its detrimental effect in favoring (*a*) air swallowing, (*b*) acquisition of infection and (*c*) facial distortion. Aggravated cases may be managed by: (*a*) Tying or pinning down the forearms, which, however, has the disadvantage of inhibiting muscular activity; (*b*) applying a stiff cuff to the forearm and hand; or (*c*) by the more drastic method of putting some bitter substance like quinine on the fingers, although the new-born is not as amenable to "object lessons" as the more mature infant.

Recurrent or continued crying is usually significant of pain, hunger or of exposure to wet or cold, all of which are ordinarily correctable; but the "spoiled" infant is a common entity, even within the first month, and its treatment is often difficult.

The procedures briefly noted here comprise only those of a general type, about which the attending physician may be consulted during the period of hospitalization. The present work does not aim to instruct mothers in the minor details of normal infant care, nor to encroach upon fields more pertinent to the child specialist. These topics are fully covered in the following works, which are available in most public libraries:

LIBRARY
ALBANY HOSPITAL
NURSING DEPARTMENT

The Expectant Mother and Baby's First Month, by Dr. F. Truby King.

The Prospective Mother, by Dr. J. Morris Slemons.

Getting Ready to be a Mother, by Carolyn C. Van Blarcom, R.N.

The Health and Care of the Baby, by Dr. Louis Fisher.

Infant Feeding, by Dr. Clifford G. Grulee.

The Care and Feeding of Children, by Dr. L. Emmett Holt.

Infant Care and Hygiene, by Mrs. Max West, United States Children's Bureau.

Short Talk with Young Mothers, by Dr. Charles G. Kerley.

CHAPTER IV.

BREAST FEEDING.

After the first few months of pregnancy the breasts contain a sticky, yellow secretion (colostrum), which is produced in somewhat larger amounts after delivery, until the time of milk production, which usually begins about the third day postpartum. The transition from colostrum to milk is smooth and gradual, but involves complex qualitative changes.

The yellow color of colostrum is due to pigmented globules of fat in suspension, while the cellular constituents are composed largely of white blood cells and epithelium. These so-called colostrum corpuscles are not present in the mature milk. The specific gravity ranges between 1050 and 1060, in contrast to 1030 for human milk, and its viscosity is relatively high. Among the soluble constituents the salts are relatively abundant (about 0.5 per cent); and in their distribution approximate the percentages found in blood serum. Sodium and potassium ions predominate, in contrast to phosphorus and calcium. The sugar (lactose) is low (about 4 per cent), rising with the advance of lactation. The nitrogen content is constantly higher than that of breast milk, although variable in amount (0.5 to 0.9 per cent), and the coagulable proteins predominate. The fat is fairly constant (3 to 4 per cent). Colostrum is known to be relatively rich in enzymes and immune bodies.

The ingestion of colostrum possesses theoretical advantages. From the standpoint of the child it furnishes a concentrated food of relatively high caloric value. It contains essential elements for growth and maintenance (vitamins),

and it is easily obtained by the child. Its so-called laxative effect is doubtless exaggerated and of little importance; at least the chemical constitution should not predispose to diarrhea. From the standpoint of the mother, the stimulation of the breasts by its withdrawal induces an earlier and more copious milk production for a child already introduced to the technique of nursing.

Successful lactation presupposes: (*a*) Adequate glandular tissue; (*b*) the hypertrophy incident to pregnancy; and (*c*) the liberation of the secretion. The fact that lactation is held in abeyance until after delivery and then established relatively quickly is a striking and constant phenomenon. While there is unquestionably a functional relationship between the ovary and the breasts, there is some evidence that the placenta is, in a measure, responsible for elaborating the product which serves to inhibit lactation until delivery. At this point the loss of this restraining influence is felt, and milk is produced. Support is given to this theory by the fact that most complete abortions are often followed by a sharp lactation reaction, whereas patients suffering from incomplete abortion remain subject to this placental influence for a relatively longer period. They lose the inhibiting factor more slowly, as it were, and so seem to experience less of a mammary reaction.

Variations are recognized in the ease and smoothness of the transition between colostrum and milk production. In a large group of cases the onset of true lactation is accompanied by an excessive engorgement of the breasts. This is not altogether a parenchymatous reaction, but is partly due to circulatory hyperemia, as evidenced by the visible vascular congestion and by the favorable response to cold applications. Under expectant and symptomatic treatment the milk secretion very quickly adjusts itself to the child's demands, while the occasional case attains this end without the intervening discomfort. It should be emphasized here that the amount of milk produced is quite independent of the size of the

breast, the end-result depending largely upon the degree of true glandular development.

The phenomenon of lactation is a very complex process. The milk is synthesized in the epithelium of the glandular tissue from primary blood constituents, and on the two sides of the delicate cell membrane exist two totally different fluids, one the derivative from the other. Milk proteins are radically different from blood proteins, and are built up from the circulating amino-acids of the blood. Milk fat is ultimately derived from the circulating lipoids, again differing chemically from the end-product, while the carbohydrate of the milk, lactose, is a disaccharide, supposedly built out of the molecules of blood sugar, or glucose, the simplest monosaccharide. It can be stated, in principle, that this highly complicated reaction ensues within the confines of a single cell, and the process goes on smoothly and automatically, producing milk in relatively huge quantities, and with no obvious detriment to the producer.

Human milk closely resembles cow's milk in its physical characteristics, except that it has blue-white coloration, the white color again being referable to globules of fat in suspension. All the other constituents are in solution.

For purposes of general comparison, the approximate percentages of the chief constituents of colostrum, human milk and cow's milk are appended.

	Colostrum (at the end of pregnancy).	Human milk.	Cow's milk.
Protein	2.25	1.25	3.50
Fat	3.15	3.50	3.50
Sugar	7.00	7.00	4.00
Salts	0.308	0.20	0.75

The remaining constituents of human milk are the non-protein nitrogen blood fractions, urea, uric acid, creatinine and amino-acids and the biological elements, generically termed vitamins.

Other substances may be transmitted through the milk

from mother to child, and any enumeration of these would necessitate a lengthy list, for there appears to be no hard and fast rule except that the simpler molecules, in general, are easily diffused. Examples of these are vegetable cathartics, alcohol, mercury, arsenic, quinine, salicylates, iodides and opiates. Experimental work has demonstrated the secretion in the milk of artificially induced toxins and antitoxins, but that of natural immune bodies seems to be highly questionable. Considering the probable complexity of such molecules, as well as the destructive action of the gastric juice upon them, it is not surprising that the infant fails to show great evidence of their assimilation. Likewise, the transmission of vitamins is evidently not altogether settled, for rickets and allied deficiency diseases will sometimes occur in an infant that has received a wholly adequate breast-milk diet.

Despite the important fact that breast milk has very rarely been proven to disagree with an infant, it is also true that minor variations in its chemical composition do occur. In the mother who is well nourished and not overworked all of the constituents of the milk should be adequate. In an underfed or highly neurotic individual a relative increase in the protein elements and a diminution in the fat and sugar have been demonstrated. The success of breast feeding, however, is much more frequently determined by the amount of milk produced rather than its composition, and this in turn varies with: (*a*) The general physical and psychic condition of the mother; (*b*) the diet; (*c*) the fluid intake; (*d*) the vitamin and galactagogue intake; and (*e*) the thoroughness and frequency of stimulation by the actual process of nursing.

It is generally conceded that breast feeding in early infancy is to be desired above all possible substitutes, and upon analysis the reasons are clear: (1) The food is fresh; (2) it is clean to the point of surgical cleanliness; (3) it is easily available at all times; (4) it is delivered at the correct tem-

perature; (5) it is economical; (6) it is naturally adapted in character and amount; (7) it is a prophylactic against disease and it is sometimes curative in itself. Furthermore, on the maternal side it is conducive to prompt involution of the pelvic organs, and to the general well-being.

The attending obstetrician can probably do more than any other agency to convince the patient of the outstanding advantages of breast feeding, and thus foster preventive medicine in its purest form.

THE TECHNIQUE OF NURSING

No phase of infant care has received more heated discussion than the question of nursing routine. There are often good arguments on either side of mooted questions, and such will be here presented, along with our own preferences toward the respective problems.

Given a functioning breast with adequate nipples, the first essential to successful nursing is a favorable habitus for the child. Suckling is *not* accomplished by the action of the tongue, but is purely mandibular, and as such, the jaws should be given every opportunity for unrestricted movement. The downward motion of the mandible draws out the nipple, and at the same time the milk flows into the lactiferous sinuses. Closure of the jaws squeezes the milk out of the ducts and into the lingual fold. Secondly, the nasal passages must be kept clear, to allow respiration to be simultaneous with the suckling process. This implies both cleansing of the nasal passages in routine care and preventing the nose from becoming "buried" in the breast tissue during the act of nursing. The child should be in a comfortable posture, so that the nipple can be manipulated without added muscular effort, and particularly should be so placed as to obviate swallowing "up hill." This applies especially to the first few days of the puerperium, when the prone position is maintained by the mother.

Regardless of the interval of feeding, it is generally conceded that strict *regularity* is essential to good results. It then remains to choose between a four- or a three-hour schedule, shorter intervals than this being indicated only in special instances, as in certain cases of prematurity. The reputed advantages of the four-hour schedule are (*a*) convenience to the mother, and (*b*) more rest for the child. Against this is the claim that the infant gains more slowly. The conditions tend to be reversed with the three-hour interval. It is our experience that the four-hour routine works best in the great run of cases, reserving the three-hour alternative for the occasional child in which one extra feeding per day bids fair to give a sluggish weight curve just the necessary impetus. It might be stated appropriately in this connection that we are dubious of the judgment of any one who always faces his problems according to an invariable formula; and that in all of medical practice the process of *individualizing* patients according to their special needs is a characteristic of the superior clinician.

Advocates of an initial twenty-four-hour period of fasting claim that uninterrupted rest is more essential than food, and that thereby the intestinal tract is more effectively rid of the meconium. We see no advantage in hastening the expulsion of meconium, and we question the accuracy of the contention; but rather feel that an initial nursing period of approximately twelve hours postpartum, depending on the time of day, not only gives the mother adequate rest from the strain of labor, but also (1) gives the child the aforementioned benefits of the colostrum, (2) stimulates the secretion, and (3) begins the all-important education of the infant for his only immediate task in life. Theoretically, the initial weight loss should also be lessened, but this is an advantage of minor importance.

It is claimed that the routine employment of both breasts at each feeding tends to the relief of congestion, particularly at first, but the assertion that it tends to earlier establish-

ment of lactation does not recognize the fact that *complete* drainage of the breast is the best stimulating device that we possess. In our practice, therefore, we advocate suckling both breasts routinely only in the occasional case in which the child is too weak to drain the breast dry, or when the milk supply is so absolutely deficient that both breasts are easily drained at one sitting.

The most logical routine practice is a compromise between the two alternatives. At one nursing the left breast, for example, is used for fifteen minutes, and is ostensibly drained completely, after which the infant is allowed to nurse for five minutes on the opposite side. The fifteen-minute interval is directed toward the mother's welfare, and the five-minute interval gives the child a small extra amount, without maternal detriment. At the next feeding the process is reversed, so that every eight hours one breast is completely drained, and so stimulated to secrete most effectively, while the child gets the equivalent of a two-breast feeding, on the presumption that the greater part of the secretion is removed in the first five minutes.

In the occasional case in which the infant regularly prefers one side, it is advisable to begin the feeding on the opposite breast. When the milk supply is persistently overabundant it is wisest to use but one breast at each nursing. A twenty-minute nursing period is adequate, and can sometimes be made perceptibly shorter without harm, but the outstanding exception to this practice is the routine of the first forty-eight hours. In this period the nipple is becoming "acclimated" to the new function, and is frequently tender and easily traumatized, particularly because little secretion is passed to act as a lubricant. Therefore, a brief five-minute nursing period on each breast during this time is recommended, in order to avoid the maceration and injury that comes with the prolonged gnawing of a dry nipple. Again, in later infancy, an active breast given to a vigorous child

well-trained in the suckling technique permits a shorter nursing interval.

With the four-hour interval the most convenient hours are often at 10, 2 and 6, day and night, but other schedules may better suit individual needs. The 2 A.M. feeding may be differentiated in two respects: (1) Its omission is recommended for the first two nights after labor to permit uninterrupted sleep for the mother, although the child should receive at least an ounce of water at that time; (2) After the sixth week the child will often tend to sleep through the 2 A.M. feeding-time, and in this event should be allowed to do so, largely in the interest of the mother. Certain authorities recommend five feedings per day from the outset, but this is not universally practicable.

In interviewing patients at the sixth week postpartum the most common habit that we are called upon to correct is the practice of feeding the child whenever it cries. This sets up a vicious cycle between gastric distress from irregular feeding and its laryngeal sign. Adherence to a strict feeding schedule and the simple expedient of giving water between feedings almost always corrects the difficulty. Obvious weight loss in the face of this routine calls for investigation of the amounts obtained over several successive nursing periods.

An adequate breast-milk intake varies with the individual child and, assuming five or six feedings in the twenty-four hours, the average will vary from 50 to 100 gm. per feeding. Variations in the amounts obtained at separate feedings are demonstrable by the weight records immediately before and after nursing. Accurate readings are best insured by the use of a balanced scale, and the metric system of weights, recorded under reasonably identical conditions. It almost invariably follows that a given intake of breast milk will carry the infant further than an equivalent amount of any ordinary substitute. As a corollary, one is frequently surprised at the successful outcome of breast feeding in cases where the average intake is small, which fact strongly suggests that

human milk is better assimilated than any of the usual food alternatives. The necessity of water in the dietary has been stressed previously, and it only remains to add that it should be boiled and slightly warmed before it is administered, regardless of the season or of the room temperature. In addition to the physiological loss of water and the weight drop during the first two or three days of life, there is a definite tendency toward dehydration thereafter, but in the average case the water content of breast milk plus that offered between feedings is wholly adequate.

The healthy infant nurses very greedily and inevitably swallows a certain quantity of air. This distends the stomach, rendering it difficult to ingest sufficient milk, and the colic-like reaction usually ends in belching the gas, together with a variable amount of the milk ingested. Such a cycle of events usually results in hunger prior to the scheduled feeding-hour, and probably has often been responsible for the pernicious advice that the mother's milk is not suited to the child and that substitutes are indicated.

Swallowed air is easily expelled at the conclusion of nursing by holding the child up with its head upon the attendant's shoulder and gently slapping its back. This allows any accumulated air to work its way to the cardia of the stomach and to be expelled by the aid of the resulting stimulation. Rarely will any appreciable amount of milk be ejected, but, on the other hand, if the child is laid prone at the end of nursing, the gas will invariably push up the milk ahead of it. When the air-swallowing tendency is extreme this procedure can be executed once or twice in the course of the nursing period.

Upon other occasions the stomach may become so overfilled with milk that a small amount will actually be "spilled over" at the end of nursing, and such is the actual impression one gains in observing the reaction, which is not to be confused with pathological types of vomiting to be described later.

One of the most constant difficulties in nursing is the tendency of the child to fall asleep at the breast as soon as the initial hunger pangs are satisfied. Unless the mother keeps the child awake for a reasonable time, it will obtain insufficient food to serve until the next feeding-time. Unfortunately, the mother is often the guilty party in this respect, particularly during the night feedings, and frequently hospital patients are treated solely by a kindly talk concerning maternal coöperation, after which an idling weight curve becomes converted into a normal one.

Successful nursing is best promoted by a rational and a liberal maternal diet. It should be emphasized that the traditional recommendations for the restriction of diet along various lines are unsound. On the contrary, a full, well-balanced intake of wholesome, well-prepared food, known to agree with the individual, is essential. The only important restriction is that of the occasional transmissible drug and of drastic purgatives, including castor-oil and the more violent vegetable cathartics, which may be secreted in sufficient quantities in the milk to affect the nursing infant. Most important among dietary recommendations is the copious intake of fluids, and particularly those designed to stimulate lactation (galactagogues). The most efficient of these is cow's milk, either in the raw form or in cocoa, egg-nogs—or malted milk, where the advantage of additional calcium ingestion is gained, to compensate for the excessive drain upon the maternal calcium reserve, chiefly in the teeth and bone. Successful nursing, in the last analysis, presupposes an adequate mammary parenchyma, and nipples that are functionally competent. Suggestions for the management of nipple abnormalities will be mentioned later.

The bowel action during lactation is best promoted by rational dietary habits, which imply regularity of meals and the inclusion in the diet of components tending to promote peristalsis, such as the coarser vegetables and fruits, both fresh and cooked. Adequate exercise and avoidance of

sedentary habits are of almost equal importance. When specific stimulation is required the use of ½ ounce of mineral oil once or twice a day or the agar compounds are satisfactory measures. An occasional low enema is recommended when necessary, but this treats effects rather than causes and, therefore, is not ideal therapy.

Adequate sleep is an important adjunct, and the omission of the 2 A.M. feeding is urged as early as the infant can tolerate it safely.

A satisfactory nursing result is best indicated by the character of the infant's rest and by the general contentment and behavior displayed. The daily weight curve or the a.c. and p.c. weights may serve as visible checks upon this tendency, while the color, the state of nutrition and the character of the stools are final evidences.

CHAPTER V.

THE PATHOLOGICAL ASPECTS OF LACTATION.

Inspection of the breasts permits no adequate estimate of their functional capacity. The relation between their size and the amount of secretory, or glandular tissue, upon which depends the ultimate yield of milk, is strikingly inconstant. Occasionally, the smallest breasts are the most prolific milk producers, while the larger types may be composed mainly of fat. Likewise, the reaction in the breasts during the early puerperium is not always a true index of their ultimate productive capacity, as the resumption of normal activity and diet after the lying-in period is often attended with marked improvement in lactation.

It was pointed out that malnutrition and overwork may render lactation relatively unsuccessful. Profound emotion, particularly constant anxiety, or protracted illness may have a similar effect, but a modification of the nursing program under these conditions is clearly in the interest of the mother, and not an acknowledgment of vitiated breast secretion. The recognition of this emotional factor is quite in accordance with the well-known empirical observation that the neurotic type of woman is often an unsuccessful nurse.

It has been stated that the recurrence of the menses may be attended with a qualitative change in the milk, but our experience has shown no perceptible clinical effect, other than a possible transient diminution in the output. In actual practice a complete nursing program usually holds the menses in abeyance until the period of active lactation is well on the wane. When the menses do recur early this fact does not contraindicate continued suckling.

Drug treatment is occasionally reflected in the breast secretion, the alkaloids being transmitted with relative ease. These should not be prescribed in any quantity for the nursing mother; but mercury and the arsenicals, administered to a nursing mother, have been considered beneficial to the luetic infant.

Care of the nipples should be begun in late pregnancy. The skin can be hardened and fortified against the trauma of nursing by the daily application of alcohol, although certain authorities recommend the opposite type of therapy—massage with a lubricant of the type of lanolin. Either procedure can profitably be preceded by stimulation with a soft brush and green soap. Retracted or depressed nipples can often be corrected and always benefited by outward traction, combined with a rotating motion, practised twice a day. In the most aggravated cases they may sometimes be induced to protrude by regular suction with an ordinary breast-pump.

Upon the establishment of nursing, freedom from subsequent difficulty depends almost wholly upon cleanliness and the early recognition of defects. As a routine procedure cleansing of the tissues with 2 per cent boric acid before and after nursing is sufficient. This may be supplemented by the application of a sterile gauze sponge to the nipples between feedings, either dry or anointed with equal parts of bismuth subcarbonate and castor oil. Some authorities prefer balsam of Peru, alone or in combination.

Cracked nipples are not only painful but are potentially dangerous. Since fissures may exist before the patient is fully aware of them, daily inspection of the tissues should be practised. The superficial cracks are frequently radial in location, while those at the basal part of the nipple tend to be circular. Upon their recognition suckling is discontinued on the affected side until healing is complete, but distention can be combated and function maintained by: (*a*) Allowing nursing through a nipple shield, which is always of doubtful efficacy, and generally yields less milk than the normal nurs-

ing procedure; (*b*) manual expression of the secretion; or (*c*) the use of the pump. Fortunately, the blood supply to the lactating breast is so rich that the healing is unusually prompt upon the removal of the offending agent, but it can be greatly promoted by local applications of: (*a*) One per cent silver nitrate; (*b*) tincture of benzoin, useful only for its alcoholic content; and (*c*) castor oil and bismuth paste. The last-named is the most effective in our experience. It is applied copiously and overlain with a square of waxed paper, or with sterile gauze pad secured with narrow adhesive strips. The only liability in its use is the purgative effect of the castor oil upon the child, unless care is taken to remove it completely prior to withdrawal of the milk. Occasionally, the tendency to cracked nipples is so obstinate that the use of the breasts has to be discontinued. The possibility of infection through the small raw areas is always present, although some authorities regard this liability as minimal, if the tissues are kept thoroughly clean. In any event, the extreme discomfort to the mother warrants early and vigorous treatment.

A certain degree of early engorgement, from an overproduction of milk in conjunction with a transient venous stasis, is often noted. Because of the appearance of an underlying hydremic plethora, the practice of restricting fluids and of administering purgatives designed to remove water from the organism has been recommended. This procedure has no rational basis and is not favored. The only indicated move is the administration of mild sedatives as necessitated by the individual case, until the acute reaction is over. The so-called caked breast implies a liberal quantity of glandular tissue and, as mentioned before, it is not peculiar to any one type of mammary gland, appearing as frequently in small as in the larger organs.

The remainder of the treatment is local and is likewise symptomatic. The application of ice-bags at intermittent periods has the effect of rendering the nerve endings of the skin less sensitive to the discomfort and has a sedative effect upon the vascular engorgement.

Binders to the breasts should never be of a constricting type, for they are uncomfortable and have no effect upon the course of the lesion. However, the added weight of the enlarged glands may be such that a *supporting* binder is very grateful. In certain cases the breast function can be more carefully regulated by the use of the pump for limited periods, provided that the pressure is kept distinctly lower than when dealing with the uncongested breast.

When it is desirable or necessary to dry up the secretion the same routine is best carried out. It is frequently a temptation to withdraw some of the milk, on the supposition that the trouble is thereby relieved, but tiding the patient over the acute period by the means just described is rewarded by a prompt regression of the symptoms and a much speedier restoration to normal.

Occasional circumstances may necessitate very early weaning. Physiological weaning is a pediatric problem, but it might be added that after the sixth month breast feeding becomes progressively less urgent, and after the ninth month may give rise to more inconvenience and maternal strain than is warranted. From the infant's point of view, increased quantity and variety in the diet is required for normal development. Some authors contend that weaning should be practised if the mother cannot furnish two adequate meals in the twenty-four hours.

Weaning is best accomplished gradually—eliminating one of the daily breast feedings at a time, in favor of a substitute, to which the child's tolerance should be carefully tested. As a general rule, any new dietary element is best given at first in small quantities, in weak solution, or both, even though it is temporarily inadequate. It is far easier to "work-up" the strength and the amount than to correct an established dietary disorder.

An extended period of breast feeding is occasionally indicated during the hot summer months, or in cases of illness in the infant, where tolerance to accessory food factors is problematic.

In this connection it is of interest to note how effectively the lactating function can be reëstablished after many weeks of inactivity. Occasionally, it is fruitless, and is often a laborious process, but can be effectively accomplished by adherence to the suggestions enumerated and by supplementing the child's efforts with the added stimulation of the breast pump.

The border-line between engorgement and mastitis is a narrow one, but the latter in its strict sense signifies *inflammation.* Thus the term is rather loosely employed, and many instances of early engorgement are incorrectly termed "mastitis," for they do not actually depend upon the presence of pathogenic microörganisms within the breast tissues. It is believed by some that true mastitis tends to follow simple engorgement since stasis of the milk flow should favor infection.

However, if upon the establishment of a normal lactating schedule there subsequently develops local heat, redness, pain and swelling, along with fever and general malaise, the diagnosis of mastitis is justified; and it only remains to treat it as any other infection with its two-fold potentiality, resorption or suppuration.

In its treatment the portal of bacterial entry is sought, and managed as outlined under the subject of "fissures." Local applications to the breast and general sedatives are similarly used. Nursing or artificial emptying of the breast is continued unless the local discomfort renders it impossible. Unfortunately, late mastitis tends to go on to abscess formation in spite of all attempts to abort it. Therefore, our instruction to nurses is that eternal vigilance in the early recognition and treatment of cracked nipples is the price of freedom from breast abscesses.

When, in addition to the symptoms and signs enumerated one finds local fluctuation and tenderness, or evidence of inflammatory pointing on the skin, associated with wide fluctuations of temperature, and leukocytosis with relatively

increased polymorphonuclear cell count, the diagnosis of breast abscess is clear. Occasionally, the pus pocket will occur practically upon the pectoral fascia and be largely reflected in constitutional rather than local signs. When there is doubt it is justifiable to perform an exploratory needling of the suspected area. Upon confirmation of the diagnosis radial incision with counter drainage is indicated. When a breast abscess is known to exist, nursing should be discontinued on the affected side, for occasionally the pus breaks into a gland duct and contaminates the secretion. A healed breast abscess that has been properly treated offers no contraindication to subsequent use of the breast, nor is the tissue predisposed in any way to a recurrence of infection in later pregnancies. On the other hand, prolonged and extensive suppuration may lead to such destruction of glandular tissue that the secretory function of the breast may be lost forever.

Relative or absolute failure of the nursing régime has three possible causes, from the maternal standpoint: (*a*) Constitutional conditions involving profound weakness and exhaustion; (*b*) insufficient gland tissue; (*c*) lack of interest or of proper instruction. The rare occurrence of idiosyncrasy to mother's milk might be added where certain proteins in the diet prove intolerable to the child. In such a case the infant may show cutaneous eruptions. Locally, any of the following abnormalities of the nipple may lead to difficulty: (*a*) Small or pointed, so that they cannot be adequately grasped; (*b*) nodulated and hypertrophied beyond the point of serviceability; (*c*) fissured; or (*d*) depressed and inverted. All of the difficulties referable to the nipple can be overcome to a certain extent, however, by artificial removal of the secretion; and in the case of the depressed nipple, the various suction devices serve the added purpose of tending to correct the inversion.

A true *hypogalactia* or insufficient production is seen at times, especially in elderly primiparæ. However, a total

inability to nurse is exceedingly rare, and a relative insufficiency of lactation is so frequently followed by an ultimate establishment of the normal status, that a persistent effort is always to be encouraged. Even though the actual amount is insufficient, every ounce of breast milk obtainable is of greatest value in conjunction with the complementary feeding utilized. In such a case the measures directed to the mother's hygiene, nutrition, environment and peace of mind, constitute the basic program of therapy. Tonics may be prescribed when indicated. The numerous galactagogues recommended are all of doubtful specificity, and should be viewed, at best, solely as adjuncts to a more comprehensive program. Stimulation by actual suckling by the patient's own infant, or by another of perhaps greater vigor; direct expression, steaming the breasts by hot applications, massage, passive hyperemia and pumping are all rational measures directed toward the breasts themselves.

On the part of the child there are several possible causes for failure: (*a*) Weakness, whether due to prematurity, congenital debility or disease; (*b*) nasal obstruction and rhinitis; (*c*) cleft palate, stenosis and atresias of the gastro-intestinal tract; (*d*) intercurrent infections, which may render nursing difficult and assimilation inadequate; (*e*) sore mouth and throat; and (*f*) general discomfort. Tongue-tie is rarely the cause of unsuccessful suckling. Occasionally, the "breast-shy" infant is encountered and the problem is one of training, rather than of local pathology.

After all of the ordinary causes of relative failure in nursing have been corrected, and the case is reduced to its essentials, there are several recourses to attempt before total failure should be acknowledged: (*a*) Increasing the frequency to a three-hour schedule; (*b*) more intensive use of both breasts at each feeding; (*c*) massage or pumping, particularly the latter, in every possible instance *after* the child has nursed. In brief, no matter what the cost, the more breast milk that can be administered to the child, in one way or another, the

more successful will be the outcome of the problem, other things being equal.

Stripping of the breast can be accomplished successfully when lactation is abundant, and is best done by grasping the skin above and below the areola with the thumb and fingers respectively, at first backward, then down, and finally expressing the contents out of the nipple. This motion is repeated as long as it is effectual, and surprisingly large quantities of milk can thus be obtained.

As an alternative to this procedure, the hand pump may prove effectual, but it is a somewhat awkward instrument and is not highly efficient in draining the breast. However, it has doubtless saved many infant lives, and altogether it serves a satisfactory purpose under many circumstances.

With the introduction of the electric breast pump, however, a new era in breast feeding has been established. As a stimulant to breast function, and as a means for draining completely the lactating breast, the child has met its peer; and the most gratifying feature of its employment is the apparent freedom from pathological tissue reactions, except when it is used at abnormally high pressures or over too long a period. In hospital practice one is now rarely forced to adopt any alternative to breast-milk feeding; while the obstetrical services now care for an entirely new type of patient, namely, nursing mothers who enter the hospital for the purpose of having a failing milk supply stimulated. Unfortunately, however, this device is accessible only to those who can avail themselves of hospital facilities, since the size and cost of the instrument make it impractical for home use.

It is usually granted that active pulmonary tuberculosis in the mother demands the cessation of nursing, because of the desirability of reducing the physical strain to a minimum and of preventing infection of the child. The liability is not so inherent in milk-borne contagion as in the constant intimate contact necessitated by the nursing process.

Syphilis in the mother does not militate against nursing

her own child, for the child is either syphilitic itself or immune, according to Profeta's law. Colles' law, presupposing paternal infection of the offspring with coincident maternal immunity, established through biological reactions incident to the pregnancy, similarly permits the mother to nurse her child without fear of contagion. However, the occasional practice of nursing a "strange" infant deserves a preliminary investigation for any luetic element, since either party may be exposed thereby to infection.

Severe constitutional diseases, anemia, leukemia, cardiac decompensation, acute nephritis, severe pneumonia and the like, may serve as contraindications to nursing, from the standpoint of maternal strain.

Severe infections may render nursing unreasonably difficult and may expose the child unduly, particularly in respiratory infections. Measles and mumps are not easily transmitted to the new-born, but the latter is highly susceptible to pertussis. Breast abscess was mentioned, and erysipelas, for example, may be similarly viewed.

Minor degrees of puerperal infection do not constitute a cause for the cessation of nursing. Severe sepsis does not alter the quality of the milk, but it may necessitate the cessation of nursing, in the mother's interest.

The onset of pregnancy may be considered adequate cause for abandoning a nursing routine, both for the avoidance of maternal strain, and because the quality of the milk appear at times to become profoundly altered and unfit for the use of the child. However, this is ordinarily a complication occurring late in the nursing program and is, therefore, rarely an acute problem.

Nursing is best suspended in the early puerperium as long as any tendency to acute toxemic symptoms persists. Nervous and psychic disorders in themselves should not contraindicate suckling, except in extreme cases. Generally speaking, any maternal disease process which carries a grave prognosis is looked upon as a stricter indication for weaning than other-

wise. Lastly, the temperament and the health of the mother are always to be considered, from the beginning to the end of the lactation period. This occasionally justifies some compromise in the nursing program, but rarely necessitates the complete omission of breast milk from the diet.

The employment of wet-nurses is finding a constantly widening field of usefulness, and not only do the more progressive pediatric clinics rely upon such services, but individuals are recognizing in them a far superior alternative to artificial feeding, in the occasional case of total inability of the mother to provide breast milk. The nurse should be free from disease, constitutional or local, and syphilis must be ruled out in every instance. She should have a plentiful supply of milk that has been created by the regular nursing of a healthy child for a period of at least two or three weeks. When a full and easily drained breast is offered to a child heretofore deprived of that advantage care must be taken to avoid overfeeding at first. From the nurse's standpoint, the active breasts must often be kept stimulated to their full capacity, either by nursing her own infant in addition, or by artificial means, since her services are usually in demand for a relatively long period, and since the infant that she is serving may drain the tissues very inadequately. The breast pump has likewise enabled such women to provide incredibly large quantities of milk over long periods, and certain city clinics dispense the milk constantly, by relying solely upon the products of a carefully selected corps of women whose breasts are drained once or twice daily. The diet and hygienic considerations advised for the nursing mother are equally if not more applicable to the wet-nurse, whose sole immediate task is that of milk production—at times in quantities much larger than that demanded of the individual patient. After the ninth month the quality and the amount produced should be vigilantly checked, and excessively long periods of lactation should be discouraged.

CHAPTER VI.

MODIFIED FEEDING.

The nutritional demands of the infant are reducible to fairly simple terms, except as special studies may require finer quantitative adjustments. It is stated that the infant requires about one-sixth of its body weight daily, in milk or substituted fluid. A child of 3600 gm. (8 pounds), therefore, requires about 600 gm. (20 ounces) of nutriment daily, averaging, for example, about 100 gm. (3 to $3\frac{1}{2}$ ounces) at each of six feedings. The caloric requirement, however, is of more significance in calculations, and in the normal full-term child the figure is about 100 Calories per kilo. Whereas the heat output accounts for about 65 Calories per kilo, the remainder is consumed in muscular activity, growth and the unabsorbed food residue. This figure also varies, in a general way, with the relation of surface area of the body, expressed in square centimeters, to the body weight in kilograms. The average areas per kilo in representative types are about as follows: Premature, 840 sq. cm.; at term, 710; age six months, 575; age one year, 525. From this it follows that the caloric demands of the premature infant are relatively high, averaging 120 to 140 Calories per kilo, while a large or fat infant, or an older child shows an increased proportion of body weight to surface area and so demands proportionally less.

The normal nursing routine may be modified in two ways: *Complemental*, or mixed feeding assumes the intake of breast milk plus an additional food to make up the necessary caloric values, offered in amounts which must be varied with the breast milk obtained at each feeding, as determined by the

weights recorded before and after nursing, but with regard for the fact that these amounts may vary with the time of day at which they are recorded. The optimum complementary amounts can be roughly determined by the response of the infant to that which is offered, but this practice is liable to error. *Supplemental* feeding, sometimes called "artificial," means a total dietary of substances other than human milk.

The present discussion is limited to problems of complementary feeding, since it is the most common method of modification, and at the same time is a more refined procedure than complete supplemental feeding, in so far as the calculations are concerned.

In the vast majority of cases complementary feeding is based upon a quantitative insufficiency of breast milk; the inability to procure a wet-nurse, or some contraindication to suckling, while later in the period of lactation the substitution of separate breast feedings for maternal relief, the beginning of the weaning process or the infant's education in extramaternal feeding necessitate similar principles of procedure.

The basic aim of most programs of modified feeding is to provide a substitute which resembles, as closely as possible, the normal human secretion in its chemical and physical characteristics. Quite naturally, cow's milk forms the basis of most modified feedings in the first month of life.

Cow's milk is a neutral or slightly acid fluid in the fresh state and is somewhat more opaque than breast milk. It is more characteristic in its bacterial organisms, chief of which are saprophytic and largely of the lactic-acid-producing variety. The protein of cow's milk, which is present in about three times the amount contained in human milk is likewise differently distributed. Casein, the predominating nitrogenous factor, is not coagulated by boiling, but is precipitated in relatively large curds by the rennin of the stomach, often necessitating its dilution when used in early infancy. Lactalbumin coagulates upon boiling, forming the characteristic scum, and is present in much larger proportion in human

milk, which in turn precipitates in much finer curds under the action of the rennin. Milk *proteins* are essentially the tissue builders, and lactalbumin in particular, contains many growth-promoting amino-acids. It is a true animal protein, and hence is especially well adapted to growth stimulation, in contrast to vegetable nitrogen. The average daily protein intake amounts to about 3.5 gm. per kilo of body weight.

Milk *carbohydrate* is the energy-producing component, through the easily oxidized sugar molecule. It spares or renders more efficient the protein assimilation and utilization, preventing the necessity of calling upon the nitrogenous elements in energy production. It necessarily must be ingested in relatively large amounts, 9 to 12 gm. per kilo, for it is utilized rapidly. Excessive sugar ingestion, on the other hand, is first recognizable by a tendency to diarrhea and eczema. Since lactose, the predominating milk carbohydrate, is reduced to about one-half the figure characteristic of human milk, it is customary to add sugar to cow's milk formulæ with the double purpose (1) of furnishing adequate carbohydrate, and (2) of raising the caloric standard to a proper figure, after dilution has been effected. Either sucrose (ordinary table sugar) or the dextrin-maltose combinations are most commonly used, the latter having a slightly more laxative effect. Many such preparations carry accessory or supplementary components, such as small amounts of added salts or vitamin extracts. As the starch radicles are approached, the tendency is toward a constipating reaction.

Milk *fat*, represented in the cream component, furnishes a part of the heat energy. It is useful as a "protein sparer," permitting a lower protein consumption in heat production, and thus allowing more for maintenance and growth. The milk fat also acts as a carrier or solvent for the vitamin A (anti-ophthalmic) component. Fat is intimately related to calcium metabolism and, lastly, it acts as an antagonist to the carbohydrate element in the diet which, in excessive amounts, promotes fermentation and diarrhea. Fat prevents

this largely by the production of "soap-stools" through its chemical effect on the intestinal contents. The usual daily intake of fat is about 4 gm. per kilo. The fat of cow's milk approaches that of breast milk in its relative proportions, but with modifications of the former, it is sometimes necessary to replace quantitatively the fat that is reduced by dilution, while certain preparations of cow's milk are also processed in such a way as to reduce the size of the fat globules.

Cow's milk is relatively rich in salts, occurring in triple the amount found in breast milk. Of these, phosphorus is the most important, in combination with calcium, which is, in turn, bound to the casein. It is said that every gram of protein constructed into body tissue requires about 0.3 gm. of ash. Iron is notably deficient in both human and cow's milk, particularly in the latter. Other inorganic constituents are more comparable in the two types.

Vitamin content is abundant and the fat-soluble A predominates, while water-soluble B (antineuritic) and C (antiscorbutic) are also present in variable amounts, depending largely upon the feed of the cow, with its seasonal variations.

Pathogenic bacteria occur in cow's milk under abnormal conditions of collection, environment or distribution, and most frequently include the typhoid-dysentery group, or the tubercle bacillus, and occasionally the streptococcus. However, regulated conditions of production under modern dairy requirements largely preclude these possibilities.

As an outgrowth of legislation and of better practice, cow's milk is now available in different grades from this standpoint: (*a*) Certified milk implies a maximal bacterial count of 10,000 per cubic centimeter, collection and distribution under regulation and a constant temperature of 40° C. or less, with delivery to the consumer under thirty-six hours. (*b*) Pasteurized milk assumes an initial heating to 65° C. for about forty-five minutes, followed by prompt cooling. (*c*) "Scalding" milk consists in raising the temperature to 75° C., and both these measures destroy most of the bacteria,

including the majority of the lactic-acid group, but the vitamin value is probably somewhat lessened. (*d*) "Boiled" milk requires the 100° C. temperature for at least ten minutes. This sterilizes the product completely, and reduces the bulk of the curd; but it may kill the vitamins and the contained digestive ferments, diminishing the nutritive value of the product. The addition to milk mixtures of small amounts of weak alkalis, such as lime water, will similarly render the curd more flocculent. The early use of orange juice and cod-liver oil will supply essential vitamins, not only in those instances of vitamin-deficient milk preparations, but in any case, their employment should be attended with beneficial effect. They should be given routinely in dosages of at least 1 dram daily, varying with the individual problem at hand.

When it is noted that *condensed milk* carries a sugar content of lactose, 11.6 per cent, and sucrose, 42.9 per cent, with fat equal to 8.8 per cent, protein, 7.3 per cent, ash, 1.8 per cent, and water, about 28 per cent, it is obvious that any dilution with water will still render the sugars too high, if sufficient protein and salt are maintained for normal development.

The natural high carbohydrate tolerance of the infant, plus the low fat and fine protein curd, predisposes to the storage of glycogen, which in turn promotes water retention in the tissues, and so contributes to an early gain in weight. Susceptibility to nutritional upsets and to infections often follow, while the end-results of underdevelopment, malnutrition and rickets may eventually appear from a feeding program deficient in quantity and quality.

Evaporated milk differs from *condensed* in that it is unsweetened, but both can be grouped together in this summary. Their preparation carries the advantage of cleanliness and the disadvantages common to all heat-treated milk products. Their convenience has led to their widespread adoption, but the voluminous exploitation of condensed milk is based in large measure upon photographs of children excessively fat-

tened with the relatively high sugar component of such a diet. Vitamins must be added to the diet specifically.

Dried milk preparations are rational, and at times indispensable. They are not subject to such subtle chemical alterations as some other commercial products, and in times of a shortage of pure fresh cow's milk, or in travelling, they furnish an excellent substitute. Their commercial preparation consists essentially in driving off the water content, which is replaced proportionally at the time of its consumption, but some products are further refined by altering the components quantitatively, prior to the desiccation process, in an effort to approximate the composition of human milk.

Buttermilk is occasionally well borne by an infant which reacts poorly to cow's milk mixtures. This product can be duplicated by treating whole or skim milk with lactic-acid bacillus preparations, with the end-result perhaps more carefully regulated.

Another very useful preparation, particularly indicated in the diarrheal conditions, is protein milk, in which whole milk is treated with liquid rennet or junket tablets, the curd cut, dried and powdered, then mixed with an equivalent amount of skimmed commercial buttermilk. It is now available in the form of dried protein milk powder, or preparations of calcium caseinate can be added to the simpler milk formulæ.

Barley water is prepared by making a barley-flour paste and boiling slowly with water, followed by straining and replacement of the water lost in the process.

Scraped meat preparations, farina gruels and vegetable broths are most useful in later infancy, but are practically never employed during the first month of life.

Many types of sugars are recommended to meet different dietary problems. For routine use cane sugar answers every purpose. Occasionally the monosaccharides are better tolerated, coupled at times with an appropriate admixture of inorganic salts.

In the practice of milk modification the total caloric content

furnishes the most satisfactory index after the basic chemical considerations are satisfied.

The use of whole milk for the new-born is impractical as a routine procedure. The practice of so-called "percentage" feeding, and the use of "top-milk" mixtures have gradually given way to whole-milk dilutions, which reduce all constituents proportionally, with subsequent additions of the separate elements where indicated. This applies particularly to the carbohydrate factor, the addition of which is demanded to compensate for the normal relative insufficiency in cow's milk, and which is still further reduced by dilution.

As a rule, weak dilutions (beginning at about 50 per cent), low-sugar concentrations (not over 5 per cent) and small feedings (60 to 75 cc.) are best tolerated at first. However, the figures can usually be increased after a very few days, gradually working up to higher concentrations of both milk and added sugar. A good working rule for the regulation of quantities of breast milk or its equivalent to be offered to an infant of average size during the first week is: "One less than the age in days $\times$ 80 cc." For example, on the third day, $2 \times 80 = 160$ cc., divided into six feedings, comes to 27 cc., or approximately 1 ounce per feeding. Up to the age of one month the strength of the formula may vary from 8 parts of whole milk in 20 parts of the mixture to a strength of 14/20, depending upon the individual case. The amount taken at each feeding rarely exceeds 5 ounces during the first month. Sugar, up to 10 per cent concentration, is well borne, except in hot weather or in diarrheal reactions, where it is best reduced.

Mixtures of whole cow's milk and water are calculated, as to caloric value, on the basis of a 20-ounce mixture, for the reason that it is a convenient amount to prepare at one time, and more particularly because each ounce of milk contains 20 Calories. Dilutions, therefore, can be read directly in caloric value in proportion to the dilution. For example, the addition of 12 ounces of whole milk, at 20 Calories per ounce,

to 8 ounces of water (12 to 20 mixture) will result in a mixture containing *12 Calories per ounce*, or 240 Calories in all. In other words, the number of calories per ounce of mixture is equivalent to the number of ounces of whole milk used in the mixture. Furthermore, breast milk in conjunction with which cow's milk modifications are oftenest employed, contains practically the same caloric value, 20 Calories per ounce.

One ounce of sugar added to the mixture will yield a total increase of about 120 Calories, or 6 Calories per ounce of mixture, varying slightly with the chosen carbohydrates. For example, 1 ounce of dextri-maltose adds 100 Calories to the mixture, or 5 Calories per ounce.

Presuming then, that the infant receives five feedings of 4 ounces each (whole milk and water, 12 to 20, with cane sugar, 1 ounce), the total calories received in twenty-four hours =

18 (12 + 6, the Calories in each ounce of mixture)
× 4 (the number of ounces per feeding)

72 (Calories per feeding)
× 5 (the number of feedings)

360 (Calories per day)

To obtain the calories per kilo, divide by the body weight in kilos. If recorded in pounds, first convert to kilos by dividing the pound-figure by 2.2.

Example (1) A child of 3000 gm. (3 kilos) is receiving 120 Calories per kilo, $\left(\frac{360}{3} = 120.\right)$

(2) A child of 7 pounds is receiving 113 Calories per kilo, $\left(\frac{7}{2.2} = 3.18 \text{ kilos}, \frac{360}{3.18} = 113.\right)$

Recently, the use of whole, undiluted, lactic-acid milk with added carbohydrate in the form of corn syrup (dextrose) has been highly recommended for routine employment. The

constant composition of the mixture renders the feeding problem simple by requiring only a gradual increase in the amount offered. A high-caloric value of 25 to 30 Calories per ounce makes it possible to give a smaller number of feedings. Prepared lactic-acid milk calls for a 10 per cent dilution by volume with Karo corn syrup, but the former can be made as occasion demands: (1) by gradually adding 3 cc. of U. S. P. lactic acid to 500 cc. (1 pint) of whole milk which has been boiled and cooled; or (2) by diluting *evaporated* milk (*not condensed milk*) with equal parts of water, adding 10 per cent syrup to the mixture, and 5 drops of lactic acid to each ounce of the final mixture. The method can be further simplified by mixing the evaporated milk with equal parts of a previously prepared acid-syrup mixture.

Although fat-soluble vitamin A is preserved, the water-soluble B and C must be supplied in orange juice, while the use of cod-liver oil, which furnishes fat-soluble vitamin D (antirachitic), is also urged as a routine measure.

In the use of evaporated milk complete sterilization and the formation of fine curds is assured, and the fat does not separate out, but remains homogenized in the final mixture.

It is clear that many infants have been reared upon diets which are wholly at variance with established metabolic principles. Furthermore, there are radical variations in the percentage contents of the nutritive factors among many of the established supplementary foods, any and all of which have many "successes" to their credit. The profession and the public are constantly regaled with exploitations of commercial products, clothed in isolated quotations from various professional sources, and designed to make it clear that he who fails to utilize the product in question is lost. Without attempting here to appraise either the truth of the assertions or the value of the products, it can be said that after the most extended trials of every reasonable food substitute, as practised under the best auspices and checked by accurate clinical records, there is an ever-increasing tendency to revert,

in general, to the simpler methods of feeding. This conclusion is in accord with Grulee's report to the 1926 meeting of the American Medical Association that of 3293 children under one year of age, in a strictly supervised clinic, 71.5 per cent were exclusively or partially breast-fed, while 7 out of 8 among those under six months of age were so managed. Except for the substitution of another sugar for sucrose, special formulæ were used in only 23 cases, and acid milks employed in but 12 of these.

Table of Equivalents.

1 Dram	=	60 minims or grains
1 Ounce	=	8 drams
1 cc.	=	16.23 minims
1 Gram	=	1 cc.
1 Dram	=	4 cc. or grams
1 Ounce	=	30 cc. or grams
1 Quart	=	1000 cc.
1 Pound	=	0.45 kilograms (450 grams)
1 Kilogram	=	2.2 pounds
1 Teaspoonful	=	4 cc. or 1 dram
1 Dessertspoonful	=	8 cc. or 2 drams
1 Tablespoonful	=	15 cc. or ½ ounce
1 Ordinary cup	=	200 cc. or 6 ounces
1 Tumbler or Glass	=	200 cc. or 6 ounces
1 Ounce of cane sugar	=	2 level tablespoonsful
1 " of lactose sugar	=	3 " "
1 " of dextri-maltose	=	3 " "
1 " of barley	=	4 " "

CHAPTER VII.

THE DIETARY DISORDERS OF INFANCY.

It can be stated with assurance that in almost every nutritional problem referable to a breast-milk diet, the fault lies in the manner or in the amount of feeding, and not in the quality of the food. Such disorders are relatively infrequent and are rarely serious in the breast-fed infant.

UNDERNUTRITION

Undernutrition may result from any of the obstacles to successful nursing which were discussed in the previous section. However, the same condition may ultimately result from too frequent feeding.

Irregular feeding intervals prohibit the essential periods of gastric repose for the child and signs of distress quickly follow. Physiological regurgitation gives way to habitual vomiting, which leads in turn to dehydration and acidosis. Colic is evidenced by painful eructations, a distended abdomen and constant flexion of the thighs. The stools tend to be frequent and of a watery, greenish-yellow appearance, containing undigested curds and mucus. The discharges are highly irritating to the flabby, parched skin and local reactions are common. Sleep is light and irregular, with resulting irritability and fretfulness. A subnormal temperature usually attends the falling weight curve.

Treatment.—The treatment of undernutrition consists in: (1) The removal or the correction of any existing cause of unsuccessful nursing; (2) the relief of the acute symptoms encountered; (3) the replacement of fluid; and (4) the adoption of a rational feeding program.

Gastric lavage and enemata are often requisite for the relief of an established colic. Colonic irrigations, so often recommended, are difficult to execute, for the passage of a soft catheter, sufficiently high to effect this measure, is practically impossible.

When the body fluids need replacement in larger quantities and in a shorter time than the instituted feedings will furnish, gavage may be employed. When the stomach is highly irritable, small proctoclyses of 30 to 50 cc. of plain tap water are well tolerated. Infusion into the subcutaneous tissues with physiological saline is well borne, and can be given in relatively large amounts, while the intraperitoneal administration can likewise be employed with good effect. The latter route calls for the use of 0.9 per cent salt solution in distilled water, in amounts from 100 to 400 cc., administered in the mid-line below the umbilicus through a short beveled needle.

The continuous nasal drip, arranged like the Murphy apparatus, is convenient for the administration of saline or glucose solutions, or even of milk mixtures, when feedings are persistently refused.

Intravenous therapy in the new-born is limited largely to transfusion or to the occasional administration of arsenicals, for the vein is not a convenient channel for routine employment. The vessels most commonly used are the veins of the arm, the external jugulars or the femorals. The employment of the longitudinal sinus for therapy of any sort should be practised only by those of broad experience in the technical procedures of pediatrics.

Feedings should be resumed as early as they can be tolerated, and their regularity is as important as their content. A temporary period of complementary feeding may be necessary, preferably with breast milk, before a satisfactory nursing régime can be established. However, it should be emphasized that serious problems of undernutrition are much more frequently seen in later infancy than in the new-born, in whom a reasonable degree of underfeeding is fairly well

tolerated, provided abundant water is given. It happens too often that complementary foods are utilized prematurely and ill-advisedly.

DIARRHEA.

Diarrhea is one of the commonest abnormal manifestations encountered in the new-born, and since it *may* signify true pathology, and always predisposes to the development of dehydration, it calls for prompt treatment. Its commonest causes are: (*a*) Irregularities of feeding in amount, in character, or both; (*b*) excessive sugar ingestion, with subsequent fermentation; (*c*) bacterial or toxic effects; (*d*) reflex causes, such as chilling, fatigue, or prostration.

This disorder is frequently associated with colic and vomiting, with resultant fever from the dehydration created. The skin is hot and dry, and restlessness along with thirst are the outstanding symptoms. The infant has a shrill cry and lies with the legs flexed, so as to relax an irritable peritoneum. The stools, in addition to their frequency and watery character, will usually contain mucus in variable amounts, but will rarely be bloody in the absence of dysentery or hemorrhagic disease. The continental clinics have reported cases of probable true bacterial enteritis in the first few days of life. This syndrome, however, has never come under our observation.

Treatment.—The cardinal principle of treatment is to stop all food and to supply water by one or more of the methods outlined. Feeding is resumed slowly, and if complemental foods are indicated in the individual case they are best chosen from the group with the least fermentative tendency, *i. e.*, whey, protein milk, fat-free buttermilk, or skim milk with the addition of barley water.

As in all digestive disturbances, small amounts are given at first and increased as tolerated, working back to the simplest milk formulæ as soon as is practicable. At all times

mother's milk should be used to the greatest possible extent, particularly in the very young infant.

When food can be safely borne, but the child refuses what is offered, gavage is useful, with due regard for the technical principles of its application, *i. e.*, lubrication and cooling of the tube, marking the point which just admits it past the cardia, and a preliminary test against its false passage into the trachea.

Occasional tepid sponges will control excessive fever, protect the tissues from damage, and act as a safe and efficient sedative. Colonic irrigations, particularly of weak soda solutions, are highly recommended by some writers as a local sedative, but their value is questioned by others.

Prolonged diarrhea, as well as any other form of water loss, results eventually in acidosis, which should be regarded simply as another symptom rather than an independent disease process. Briefly, the eliminating and neutralizing mechanism of the child is disturbed, and upon its recognition, is correctable by the administration of weak alkaline solutions, or glucose, preferably by mouth or vein, but less satisfactorily by rectum, and less safely by the peritoneal route.

COLIC.

Colic is a generic term signifying a referred pain from the stomach or intestine due to distention or to spastic contraction. It is more frequently caused by irregular feeding habits than by unsuitable food. Rapid eating and thumb-sucking, when considerable air is swallowed, is the commonest cause, while gas from fermentation, impaction of protein curds, or unsuitable environment resulting in chilling or fatigue, may be contributory factors. A shrill cry, flushed and cyanotic face, clenched fists, cold extremities, flexed thighs and a distended abdomen appearing soon after the ingested meal constitute the characteristic clinical picture.

Treatment.—The condition is met by the rational correction of feeding habits, the prolongation of feeding intervals, alterations in the complementary feeding, if necessary, and the use of enemas as indicated. Here again, the free administration of water is particularly advised. The more elaborate measures for combating ileus employed in the adult are rarely called for in the management of the infant.

CONSTIPATION.

The incidence of severe constipation in the new-born and the very young infant is much exaggerated. However, it does occur to a certain degree and may be referable to the diet either in content or in the manner of feeding, to intestinal atony, occasionally to an anal fissure, but more often to habit alone. This functional disturbance of the intestinal tract furnishes a striking example of the early establishment of reflex activity in the child, which may be directed to useful purposes by early training, or with neglect may lead to obstinate habits.

Treatment.—The two basic principles underlying the treatment of constipation are: (*a*) Determination of the cause; (*b*) correction of the dietary elements in the problem. The establishment of normal feeding methods, as outlined, plus abundant water, goes far toward the cure of most cases. This is well supplemented by gentle massage in the direction of the normal peristaltic wave of the colon at a regular hour every day, which maneuver is generally followed in a reasonable time not only by a normal bowel movement, but, better, by the establishment of a regular habit. The cause of an apparent constipation in the first days of life is usually due to a simple insufficiency in the intake.

Among all the disorders of the new-born in which medication, *per se*, is rarely indicated, this is the outstanding example. Any drug, sufficiently potent to affect the intestine is equally certain to upset the normal and delicate digestive

processes. Among normal food modifications, however, there are some ingredients which will promote freer bowel activity, such as the addition of maltose, malted milk or small amounts of milk of magnesia to the usual cow's milk formulæ. A specific aid toward better bowel action is mineral oil, a few drops of which instilled into the nose once a day furnish an effective and harmless lubricant both for the intestine and the mucosa of the naso-pharynx, thus tending to prevent upper respiratory infections through an otherwise drier surface. Prune juice can likewise be given by mouth, while infants past the new-born period may derive sufficient stimulation from orange juice.

The relief of more acute constipation is very effectually accomplished by the soap stick. This ordinarily harmless expedient, however, may result in habit formation, so that the normal function comes to *depend* upon such stimulation. The same is true of enemata, as well as the use of oil injections.

In brief, the behavior of the distal end of the gastro-intestinal tract of the new-born depends almost wholly upon the selection and mode of administration of the diet, and accessory treatments should be reserved for the individual case.

VOMITING.

There are about six common causes of vomiting in infancy, and of these, and first and by far the most important is:

(*a*) *Dietary Error.*—Rapid feeding is accompanied by the swallowing of air which tends to find its way out, upon the completion of the nursing interval by the mechanism previously mentioned. Nursing the child in several briefer instalments and eliminating the gas from the stomach at each interval is the cure for this type of vomiting. As was likewise mentioned previously, the next most common cause of vomiting immediately after nursing is gastric engorgement and the act is a simple regurgitation of the over-supply past

the cardiac sphincter, which is normally weak in contrast to the more spastic pylorus.

(*b*) Acute gastric indigestion comes on later than in the former case, and is seen after an ill-advised supplementary diet, usually high in fat or sugar, or in one where the curds are excessively large and tough. It is almost unknown after properly administered breast milk. If constitutional symptoms accompany the vomiting, (diarrhea, pallor, excessive perspiration, evidences of pain and fever) the treatment is much the same as that described for the symptom diarrhea.

(*c*) Pyloric stenosis ordinarily has its onset after the second week, rarely before the tenth day, and the associated vomiting is characteristically projectile in type. Incident to the picture, gastric waves are usually visible running from the left costal margin diagonally across the abdomen, at times with incredibly long sweeps, and at fairly regular intervals. The picture is so characteristic that there is rarely any indication for delaying surgical interference.

(*d*) *Intestinal obstruction* occasionally results from congenital stenosis or adhesion formation, but more frequently from intussusception or volvulus. This most often begins at birth and the vomitus is likely to be colored with bile, and occasionally with blood and mucus as well.

(*e*) *Rumination* or habitual vomiting is rarely seen in early infancy, although it has been observed in the second month. It is a pediatric problem and often a most difficult one.

(*f*) As in later childhood, vomiting may be an early symptom of an acute infection, and its possibility should be considered whenever the vomiting is sudden and otherwise unexplained.

Vomiting in the first twenty-four hours of life represents an effort to rid the stomach of amniotic fluid, vaginal secretion, or blood. It may be clear or streaked with blood and mucus, and is usually of no significance.

Treatment.—Treatment depends always upon underlying causes. The usual measures to be adapted to the individual

case are: (1) Alterations of diet to simpler forms, preferably human milk, when possible; (2) strict regularity in the schedule of feeding; (3) reduction in the size of the feedings, when necessary; (4) reduction of curd in cow's milk mixtures by alkalies or by boiling; (5) gavage and refeeding in selected cases; (6) atropine, gr. $\frac{1}{1000}$, in spastic conditions; (7) treatment of dehydration when necessary; (8) avoidance of manipulation; and (9) expulsion of air, as described.

The best index of nutritional well-being is the weight curve, with due consideration to the constitution of the child. The latter is a complex problem, and it frequently happens than an apparently well-nourished child may be more susceptible to disease than an infant of lesser weight and development. The weight curve of a normal infant shows a progressive rise, but its characteristic appearance is a zig-zag, or "stair-case"-like line, with frequent small depressions in the course of the general ascending tendency. It is likewise to be remembered that a breast-fed infant tends to gain more rapidly at the outset than one upon a supplementary diet. Next in importance as prognostic signs are the child's apparent comfort, the disposition, character of the sleep, the stools and the general appearance.

CHAPTER VIII.

BIRTH INJURIES—CRANIAL.

The subject of birth injury is limited arbitrarily to a study of the mechanical traumata sustained in the course of labor. Such injuries, ranging from minor involvements of the cutaneous tissues to serious hemorrhages into the internal organs, may be encountered during normal delivery; but they occur with far greater frequency during some operative interference with the mechanism of labor.

The subject of birth injury has been studied with renewed vigor in recent years. This is not only due to its recognition as a topic worthy of inclusion in the larger program of infant mortality reduction, but also to its frequent incidence, which must necessarily be increased by the more extensive employment of the many measures recently advocated for the shortening of labor or for the alleviation of its pains. Such measures include the use of "prophylactic" forceps, manual dilatation of the cervix and elective version, followed by breech extraction, the use of pituitrin in the antepartum period and the routine employment of various types of analgesia, which in turn tend to increase the incidence of operative interference. The usefulness of any and of all the procedures mentioned is beyond question in the hands of experienced operators who individualize their cases, but it still remains to be proven wherein the child is benefited, except in the occasional case of impending fetal asphyxia.

First in importance and frequency among birth injuries are those affecting the head. Frequently such traumata are limited to the surface tissues, and are there manifested by one of three characteristic lesions or by combinations of them.

CAPUT SUCCADANEUM.

The caput succadaneum is a birth injury, in spite of its frequent occurrence and its negligible significance. This transudate within the subcutaneous layers of the scalp often in association with skin ecchymoses or hematomata of the underlying tissues results from the discrepancy between the intra-uterine and extra-uterine pressure within the area of the dilating cervix. The extent of the lesion varies with the strength of the contractions, the duration of the applied pressure and the rigidity of the obstructing tissues. It is characteristically present at the time of birth as a diffuse, compressible and movable swelling, which is absorbed within a few days.

Its possible obstetrical significance is three-fold. It may obscure the actual degree of descent of the vertex during labor; it may simulate the bulging membranes and so confuse the clinical picture; and it may serve as another check upon the diagnosis of the position *in utero*. In the occasional involvement of the face, nursing may be temporarily compromised. Secondary infection is a rare complication.

CEPHALHEMATOMA.

Cephalhematoma is a subperiosteal hemorrhage most frequently involving one or both parietal areas, occurring oftenest in males, over-sized infants and in the children of primiparæ. Its occurrence is more frequent in forceps deliveries, but it frequently develops during the course of a normal spontaneous labor. It is limited to the bone where it arises by the dense adhesion of the periosteum to the matrix at the borders of the flat skull bones.

The lesion develops from intermittent pressure, applied tangentially to the head in such a manner as to traumatize small vessels beneath the periosteum. Such an effect is thought to be favored where small degrees of lateral motion

are permitted within the bony pelvis, while a similar mechanical effect is enhanced by an abundant hair development.

It is usually not apparent at birth, but develops on the second or third day, gradually increasing in size until about the seventh day, when the sac becomes lined with a gelatinous material in which the osteoblasts at the periphery commence the deposition of a ring of new bone, a characteristic finding upon palpation.

The cephalhematoma differs from the caput succadaneum in its elastic, fluctuant and non-reducible character; in its circumscribed and fixed location; and in its relatively persistent character. It differs from an *encephalocele* in that it does not traverse the suture lines, is irreducible and does not move with respiration. In the vast majority of cases spontaneous absorption within six to eight weeks is the rule, and surgical intervention is practically never indicated.

The occasional complications are: (*a*) An associated intracranial hemorrhage; or (*b*) an infection, which may remain localized, or may extend to the meninges, or to the general circulation.

INJURIES OF THE SCALP AND FACE.

Injuries to the scalp and face consist chiefly in marks or excoriations which result from pressure upon the sacral promontory or upon abnormal pelvic exostoses; or, more frequently, from forceps blades, which may injure the skin by prolonged pressure, rotation, slipping, or traction through an extremely tight outlet. Although healing is prompt and uncomplicated in most cases, infection, necrosis or scarring occasionally ensue. Injury may result from mistaken diagnosis of bulging membranes, wherein a caput, meningocele or hydrocephalus is punctured. Amniotic adhesions are rare, usually leaving a sharp-edged ulcer, often with evidences of intra-uterine healing. They are frequently associated with other similar skin defects.

INJURIES OF THE CRANIAL BONES.

Intermediate in type between the surface injuries and the serious lesions of the central nervous system, and often associated with them, is involvement of the *cranial bones.*

Depressions of the Calvarium.—Depressions of the calvarium are usually spoon-or groove-shaped, and they occur most frequently over the parietal bone, unilaterally. The causative factor is usually the sacral promontory in contracted pelves, while forceps blades are usually only a contributing factor. Although many such lesions are not associated with hemorrhage, their correction is best attempted early, because of the liability of pressure injury to the brain. Occasionally these depressions yield to such local manipulations as lateral pressure, whereupon the affected bone springs back like parchment. Failing in this, surgical intervention is urgent, and the older method of raising the depression by a trephine acting like a corkscrew has been replaced by the open operation wherein a bone flap is turned down, and the digital replacement of the depression within the flap is followed by exploration of the underlying tissues for associated evidences of trauma.

Fractures of the Skull.—Fractures of the skull rarely occur in spontaneous labors, in spite of the occasional occurrence of intracranial damage without operative interference. Breech extraction and difficult forceps delivery have preceded most of the recorded examples. The peculiar behavior of fractures of the skull in the new-born depends upon the incomplete ossification of the cranial bones. Most fractures cross the radial lines of ossification in the flat bones, in contrast to the occasional *fissures* which tend to follow these lines. Consequently, they rarely show displacement. Basal fractures, as well as those involving the facial bones (orbit, mandible, etc.) are very uncommon.

Whenever an actual break in the continuity of the skull occurs, cerebral injury from hemorrhage, edema or direct

pressure is almost inevitable, whether or not it produces recognizable symptoms. Consequently, questions of prophylaxis and treatment cannot be divorced from the general problems presented by intracranial injuries which are discussed in the section to follow.

INTRACRANIAL INJURIES.

Lesions of the central nervous system are arbitrarily divided into those involving the cerebral, spinal and peripheral components, but these are so interrelated with one another and to associated lesions of the contiguous bones, that a strict segregation is rarely possible. The present section, however, aims to stress the intracranial types of injury.

Knowledge of the underlying pathology has been greatly increased through autopsy methods designed to preserve the tentorium. The best means of accomplishing this is to incise the skull sagittally on each side of the longitudinal sinus and to expose each hemisphere by the outward displacement of the parietal bones.

The most recent available study of this subject is by Ford,[1] where the classification by Capon is quoted. In this review stress is wisely placed upon the sources of bleeding and the natural anatomical consequences, since the majority of intracranial lesions produce symptoms through the associated hemorrhage.

1. *Rupture of the vessels of the tentorium* may be followed by: (*a*) An upward extension of the hemorrhage into the temporal fossa and over the convexity; (*b*) posteriorly, to the occipital lobes; or (*c*) downward, over the cerebellum and medulla, and into the spinal canal and subarachnoid space.

2. *Rupture of the vena magna Galeni* may occur at the junction with the straight sinus, whence the blood drains downward around the pons, cerebellum and medulla.

[1] Ford, Crothers, and Putnam: Birth Injuries of the Central Nervous System, Medicine Monographs, vol. **xi.**

3. *Rupture of the cerebral veins* may follow stretching between their fixed attachment to the longitudinal sinus and the more freely movable brain.

4. *Rupture of the longitudinal, transverse or straight sinus* is only seen after the most severe trauma. Still-birth is the rule.

5. *Rupture of internal cerebral veins* is very rare. Occasional involvement of the choroidal vessels produces hemorrhage into all the ventricles as well as into the spinal canal and subarachnoid space.

It is well established that most hemorrhages are subdural in type, but it is at once clear that the foregoing classification of the sources of bleeding is more rational than the former practice of emphasizing the actual layer of the meninges into which the hemorrhage finally seeps.

The occasional extradural hemorrhage is probably the result of fracture of the skull without involvement of the meninges, simple rupture of a meningeal artery being extremely rare in infancy. The adherent character of the dura prevents these hematomata from becoming large or clinically important. The term, internal cephalhematoma, should be regarded as a misnomer, for it is inconceivable that the same forces which produce the external type could operate within the skull.

Whereas most birth injuries are immediately of mechanical origin, the type and the outcome depend upon many accessory factors. In premature infants the skull is thin and the vessels are fragile. Asphyxia may be followed by multiple small hemorrhages into the brain and meninges, but it is doubtful whether larger vessels rupture from this cause alone. However, hemorrhage from a torn vein may be greatly increased by a coincident congestion. The hemorrhagic diathesis furnishes a third variant; the rôle of syphilis is problematic.

Although the cushion of cerebrospinal fluid permits relatively wide mobility of the cranial contents, injury ensues

when the normal elasticity of the skull and its contents is overtaxed by moulding, overlapping or sudden force. The resulting lesion is a contusion, concussion, edema or vascular rupture. These are further favored by the sudden release of an extremely moulded head upon precipitate delivery, along with a rapid readjustment of intracranial pressure.

Injuries to the tentorium result from lateral pressure, whereby the antero-posterior diameter of the head tends to a compensatory elongation. The longitudinal fibers of the falx cerebri swing across the tentorium on each side, and this point of junction is the weak spot of the system. Thus traction upon the falx often results in rupture at the tentorium.

Breech extraction tends to injure the tentorium by direct upward pressure of the cerebellum against its lower edge. Crothers explains these injuries as the resultant of: (1) The downward force of the uterine contractions (often in association with manual suprapubic pressure), which tend to compress the wall of the supratentorial chamber, along with (2) traction on the body from below, which draws the medulla down, thus favoring tentorial rupture or even herniation of the medulla into the foramen magnum. Likewise, compression of the trunk during breech delivery causes intense intracranial congestion, by forcing blood out of the venous reservoirs of the chest and abdomen, back through the incompetent valves of the jugular veins, into the head and neck (Ford).

Many instances of minor cerebral injuries doubtless escape notice because they are unaccompanied by easily recognized clinical symptoms. On the other hand, large extravasations ordinarily cause death at once, or shortly after delivery, particularly in medullary involvement. However, the borderline cases between these two extremes often furnish intricate diagnostic problems.

From the outset it is emphasized that the axioms of neurology are tremendously modified, if they do not become wholly inapplicable, when the central nervous system of the

new-born is under consideration. To begin with, the examination is entirely *objective,* which necessarily reduces the scope and efficacy of a neurological study. The tendon reflexes are inconstant and misleading. Examination of the eye-grounds is difficult and unsatisfactory, for, in addition to the technical difficulty of overcoming blepharospasm, the procedure is rendered less valuable and conclusive by the fact that edema and hemorrhage into the retina result from the congestion incident to about 20 per cent of *all* deliveries, running up to 50 per cent in difficult labor complicated by contracted pelvis.

Furthermore, since the pyramidal tracts arising in the cortex are non-medullated, and presumably non-functional at this age, the fore-brain is ruled out as a helpful adjunct for localizing the lesions, while the same fact renders the mechanism underlying a convulsion somewhat obscure, in spite of the traditional association of convulsions with a hemorrhage over the convexity.

Again, the fontanelle, which may offer clear evidence of intracranial pathology in older infants, is a less accurate index in the new-born, because of the expansile character of the calvarium with its wide sutures and mobile bones. A bulging fontanelle may follow a large hemorrhage, involving the hemisphere or the ventricle, or it may accompany an extensive edema of the cortex, yet it may be quite unaffected in small hemorrhages or in those which are wholly infratentorial.

The diagnosis of intracranial hemorrhage will often be suggested by associated factors, *i. e.,* the character of the delivery, the previous obstetrical history of the mother and external evidences of injury to the child. Difficulty in the establishment and maintenance of respiration is often the first suggestion of intracranial hemorrhage. The circulatory and respiratory centers are depressed upon involvement of the medulla, and this is oftenest manifested by a slow pulse and shallow, rapid breathing. Altered neuro-muscular tonus

is evidenced by disturbed sensation and motor irritability (hyperesthesia, hyperactive reflexes, twitchings, rigidity and convulsions, which are usually clonic, intermittent and of variable character). Pallor of the skin is ascribed to vasomotor stimulation, but cyanosis is noted in other cases and is logically explained by the continuously depressed circulatory and respiratory functions.

The eye movements of all new-born infants show such a lack of coördination that nystagmus and strabismus are unreliable signs of intracranial injury, while ptosis of the lid is very rare, and suggests involvement of the oculomotor nerve, sometimes manifested further by a contracted pupil on the same side.

A weak and shrill cry, like that of a premature infant, signifies pain which has been ascribed to stretching of the dura. Periods of restlessness may alternate with somnolence or coma, and the desire for nourishment is altered or absent. An affected infant yawns excessively.

If improvement in the original picture occurs it should be evident by the third or fourth day, although the occasional reaction is delayed. In the basal lesions early death is the rule, and is commonly associated with the advent of spinal symptoms—neck rigidity and opisthotonos. (The term *basal*, in this connection and subsequently, refers to the structures about the medulla, in contrast to the basal portion of the cerebrum, which is described as the region of the basal ganglia.)

Since the tentorium has been recognized as the source of so many hemorrhages, and since the prognosis varies so definitely according as the hematoma localizes above or below this structure, it is of interest and importance to attempt a differential diagnosis.

Supratentorial bleeding oftenest affects the convexity, or the *basal ganglia*. In the former event symptoms usually predominate on one side, although the hemorrhage may actually be bilateral. The upper cortical lesions tend to

cause clonic convulsions, which are easily elicited by sensory stimuli, and which are likely to be predominant in the flexors of the extremities, while the latter members are likewise most frequently affected by a subsequent paralysis. Upward rolling of the eyes and facial twitchings usually accompany these convulsions. Intracranial hypertension with a tense fontanelle may appear early, and such infants cry excessively. Pallor is a prominent sign, but respiration is usually unaffected except as a terminal manifestation, and the same is true of opisthotonos and neck rigidity. The latter complication presumes an extension of the hemorrhage to the medulla.

Infratentorial hemorrhage arises from the transverse sinus or from the edge of the tentorium, and collects around the cerebellum and medulla, or it may even enter the spinal canal and subarachnoid space. Its occasional association with a cortical hemorrhage has been pointed out. The cardinal signs of such a lesion are an early rigidity of the neck, opisthotonos and shallow breathing, with intervals of cyanosis. Lethargy and coma are the rule, but signs of intracranial hypertension are comparatively uncommon. Early death usually ensues from paralysis of the vital centers. *Hemorrhage into the ventricles* arises from the straight sinus, the inferior longitudinal sinus, or the veins of Galen, and the symptoms resemble those of a basal hemorrhage, particularly if the bleeding advances into the fourth ventricle and spinal canal. Convulsions from this source are often stated to be more characteristically of the tonic type.

As a specific aid to diagnosis, lumbar puncture is now regarded as practically indispensable. Unless the bleeding is limited to the anterior fossa, it soon finds its way into the basal cisterns, and will appear in the spinal subarachnoid space upon lumbar puncture. Whether the blood is freshly mixed with the fluid or has hemolyzed and has given a yellowish tinge to the mixture depends on the time which has elapsed following the hemorrhage. Care must be taken to

rule out the possibility of accidental bleeding caused by the entrance of the needle. Cisternal or ventricular puncture can be performed with the same diagnostic aim in view, but the technical difficulties, especially in the former, tend to limit their usefulness.

Accessories to a complete diagnosis might include the determination of clotting-time, preferably by the watch-glass method of Rodda, where the normal reading is from five to nine minutes, and an estimation of the bleeding-time, which is normally from two to five minutes.

The prognosis varies directly with the location and extent of the hemorrhage. The cortical contusions mentioned, in which the lesion consists essentially of hyperemia, edema, or a series of punctate hemorrhages, usually present a milder variation of the "hemorrhagic"syndrome described, but, as a rule, recovery is more prompt and definite. Involvement of the brain stem, directly or secondarily, always renders the prognosis grave. Convulsions which give way to paralyses often signify irreparable tissue damage, but recovery is not unknown. Finally, the occasional case may succumb to to secondary changes induced through local infection or constitutional disease, for example, pneumonia, in the wake of a depressed respiratory function.

The likelihood of a residuum in later life is hardly less important than the immediate problem. It remains very questionable whether profound psychic disorders, mental deficiency and organic neurological lesions can be as generally ascribed to birth injuries as has been the custom in the past. Very few authentic series of carefully recorded labors in relation to the subsequent adult reaction are available, and even here there is no constant relationship between suspected birth injuries and later mental defects. Anatomical evidence obtained at postmortem examinations of older infants and children is unconvincing, despite the occasional association of mental defects with pachymeningitis hemorrhagica, porencephaly and hydrocephalus. This whole subject is, as yet,

highly controversial, and further discussion of the evidences of birth traumata in later life is beyond the scope of this work.

Similarly, with regard to the frequency of birth injuries, statistics need not be detailed here, but the following conclusions seem well established: (*a*) Intracranial lesions may follow both normal and abnormal labors, and such injuries are demonstrable in about 50 per cent of infants, still-born or dying within the first few days; (*b*) postmortem evidence of intracranial injuries are often seen, up to two years, with or without clinical signs; (*c*) intracranial birth injuries are frequently followed by permanent cure.

Treatment.—The treatment of intracranial traumata falls into two chapters: the first, the most important and the most effectual, is *prophylaxis*.

Circumstances which are beyond the attendant's control, viz: prematurity, syphilis, hemorrhagic diathesis, may furnish predisposing factors. On the other hand, contributing elements which are at times more amenable to regulation consist in sudden or excessive cranial compression, asphyxia and ill-advised resuscitation measures. Difficult labor has been variously defined and interpreted, but too often in terms of mere prolongation. The latter is attributable largely to the first stage, which is not ordinarily conducive to injury. Most damage is referable to the second stage and to the delivery, especially when operative methods are used, or when the head is subjected to extreme or rapid accommodation. Generally speaking, the induction of premature labor should be reserved for the most urgent cases, for the problem of prematurity is scarcely less important and difficult than that of injury. In line with this conception, it should be noted that such induction for the sole indication of contracted pelvis is rapidly giving way to the more general use of Cæsarean section at term, whenever the individual circumstances warrant the operation.

Head injuries will become less common when it is more

generally appreciated that the use of *pituitrin* in the antepartum period always carries this liability, in addition to its potentialities as an asphyxiating agent through the long-continued ischemia produced at the placental site. Similarly, it has been pointed out that the Ritgen maneuver executed too vigorously may subject the occiput to excessive degrees of pressure beneath the pubic arch.

The damaging effects of high forceps are too well known to require further emphasis; but even the more benign use of low forceps may result similarly by: (*a*) Extraction through an incompletely dilated cervix or through a spastic outlet, instead of resorting to the clearly indicated episiotomy; (*b*) erroneous diagnosis of position, with abnormalities of pressure resulting from improperly applied forceps blades; (*c*) forcible delivery through a contracted pubic arch not properly compensated by an adequate posterior sagittal diameter; or (*d*) forcible and rapid extraction from any cause, in contrast to a "studied" and deliberate delivery.

The frequent reference to the rôle of contrasted pelvis as a factor in the production of cranial injury brings up a fundamental rule of obstetrical practice which cannot be emphasized too often. An oversized head in the presence of a normal pelvis raises the same problem as when a normal head is expected to adapt itself to a contracted pelvis. The method of conducting labor and the optimum type of delivery is by no means determined by the results of pelvimetry alone, as the procedure of choice often remains a problem until the labor is well advanced. Briefly stated, the passage is of immediate importance only in relation to the passenger concerned.

Management of the aftercoming head is a problem that is automatically solved by the successful performance of external version, a procedure which is viewed too pessimistically by many authors. Patient efforts, repeated if necessary, result in permanent reversal of the fetal poles in the *majority* of cases, provided that the maneuver is not

precluded by the familiar contraindications of oligo-hydramnios, irritable uterine musculature and the like. When it is recalled that the delivery of a child by the breech carries, in addition to "intracranial" possibilities, those of asphyxia, fracture, sterno-cleido-mastoid hematoma, peripheral nerve injuries and the "vertebral" syndrome, the desirability of attempting the procedure becomes even more urgent.

Assuming the necessity of delivering the fetus by the breech, the cardinal principles remain: (1) Maintenance of flexion of both head and arms; (2) preliminary stretching of the perineal floor, supplemented by episiotomy when necessary; (3) distribution of the exerted force between the suprapubic area and the delivered portion of the body; (4) the application of forceps to the after-coming head, when preferred by a trained operator; (5) the employment of an intelligent assistant for aid in the abdominal maneuvers, particularly when the extraction has been preceded by an internal podalic version; and (6) the all-important necessity of avoiding haste, in spite of the ominous "eight-minute" threat.

As we have pointed out, the growing practice of routine analgesia in labor harbors its dangers, and it should always be remembered that the undeniable maternal advantages are at least partially overbalanced by an increased tendency to fetal asphyxia and operative delivery. Our only recommendation here consists in the practice of reserving profound narcosis for the clearly indicated case, and then limiting the dosage to the smallest amount that will serve the desired purpose.

In all types of intracranial trauma the main therapeutic resources are those of a sustaining rather than of a curative nature. The basic principle is the maintenance of perfect quiet, whereby thrombosis may occur to best advantage, and the external application of heat for sustaining body temperature. Nursing is suspended and food is supplied by gavage, while water may be given by proctoclysis, and saline

by infusion. Respiration may require the artificial aids described under resuscitation measures, along with oxygen and carbon dioxide administration in selected cases. This likewise tends to prevent cyanosis, venous congestion and subsequent liability to further bleeding.

When lumbar puncture reveals bloody fluid the procedure should be repeated daily until clear fluid is obtained, in order to remove the irritant blood while it is fluid, and prior to the organization stage, where obstruction is likely to ensue. Decompression is sometimes followed by excellent results in hemorrhages limited to the anterior fossa, but in general it is resorted to far less frequently than during the experimental period in the development of brain surgery.

CHAPTER IX.

BIRTH INJURIES—EXTRACRANIAL.

VERTEBRAL AND SPINAL CORD INJURIES.

Injuries to the vertebræ and to their enclosed nervous elements must be considered together, in the same manner as were discussed birth traumata to the cranial bones and to the intracranial structures. Again, one of the commonest sites of birth injury to the column and cord is in the portion adjacent to the medulla; and, since the vital centers may be affected in much the same manner as in the basal injuries previously described, the clinical picture in the two types may be almost identical.

Such injuries, which most commonly follow breech extractions, are generally referable to the application of one or more of the following mechanical forces: (1) Torsion, (2) lateral flexion and (3) hyperextension. When traction is simultaneously added to any of these forces the danger is considerably augmented.

1. **Torsion.**—A certain amount of torsion is inevitable in the course of any breech extraction, but the "torsion effect" is intensified when rotation and traction are coincidently applied to the delivered body while the vertebral column is fixed in the birth canal, as, for example, by impacted after-coming shoulders, or by a head which is incompletely rotated beneath the pubic arch.

2. **Lateral Flexion.**—The delivery of the shoulders, by extreme degrees of lateral flexion in the course of either a vertex or a breech presentation, may be attended by unilateral rupture of a cervical joint capsule; or by the separation and dislocation of a vertebral epiphysis; or may even result in

excessive stretching or complete avulsion of the brachial plexus, with associated injury to the cervical cord.

3. **Hyperextension.**—Following a long period of extreme flexion *in utero*, extension of any portion of the vertebral column is poorly tolerated at birth. This force, however, is ordinarily apt to be exerted under three conditions: (*a*) In the usual maneuvers incident to breech extraction, particularly when obstruction is present; (*b*) in forceps delivery of the vertex in the occipito-anterior position, where such a maneuver is exerted to avoid injury to the perineum; and (*c*) in the course of certain methods of resuscitation.

The elasticity and flexibility of the vertebral column allows considerable distortion without actual fracture, but epiphyseal separation in the fifth or, more commonly, in the sixth cervical vertebra, is thought to be favored by the relative thinness of the intervening fibrocartilaginous disc, as well as by the inadequacy of muscular protection at that point (Hofbauer). However, the other cervical segments are involved at times, the first and the lowermost being the only ones which ordinarily escape. Vertebral injuries in the thoracic and lumbar areas are much less common, but it has been suggested that certain spinal curvatures of later life may have had their origin in subluxations sustained at birth, which were followed by inequalities of bony growth. Simple vertebral injury rarely gives rise to a definite clinical picture unless the trauma is very severe.

Although the cord is protected to a certain extent by the vertebral column, injury to the latter may, in turn, damage the cord, either through pressure exerted by the adjacent fracture, or through the original forces which damaged the more resistant covering. On the contrary, spinal injury may appear alone, without a demonstrable lesion in the bony elements, due to the fact that the cord is relatively inelastic, delicate and friable. Furthermore, it is firmly anchored at the cervical and lumbar enlargements by the roots of the brachial and lumbar plexuses, so that traction may result in

trauma long before the strain becomes intolerable to the more elastic vertebral column.

The lesions thus produced in the cord are extremely variable. Multiple pin-point hemorrhages, or large single hematomata, may occur. These may be confined to a segment; to a "column" extending over several segments; or they may be "meningeal," resulting in extensive cord destruction.

The clinical picture will vary with the location and extent of the lesion. Minor injuries to the cord often pass unrecognized, or referred symptoms may clear up quickly; but the serious traumata, on the other hand, should be readily diagnosed by the flaccid paralysis and anesthesia below the lesion. When the medulla is affected by pressure, hemorrhage or impaction into the foramen magnum, early asphyxia pallida and generalized paralyses are the rule. In such cases the phrenic nuclei are frequently involved as well, leading to early death. Injuries at a lower level, from stretching or rupture of the cord between the fixed points at the plexuses, may likewise be of a serious nature, since the trophic skin changes below the lesion, along with generally impaired sensation, and the paralyzed bladder sphincter all favor an extending infection which is often fatal. If, however, this liability is surmounted the prognosis for life is fairly good.

Crothers points out that the relative friability of the tissues as contrasted with those of the adult, results often in diffuse and serious injury, in contrast to sharply localized damage. The ultimate pathological picture is described as a fixed, diffuse, non-selective and essentially non-progressive condition.

Lastly, because of the difficulties of examination and of interpretation of neurological symptoms and signs in the new-born, the nearest approach to a clinical classification of such injuries is as follows: "Some show flaccid paraplegia, apparently due to almost complete destruction of the lower cord. A second group exhibits lively reflexes dependent upon the isolated part of the transected cord, while a third are handicapped by disturbances due to perverted control as a

result of partial destruction of afferent or efferent tracts. Obviously coincident injury of the brachial plexus or of the brain will produce variations which may be confusing." Since the "intelligence" areas of the cortex and the phrenic nerve centers are usually spared, many of these cases come to the neurologist for subsequent management, when the functional residues of the injuries are utilized to best advantage.

From the standpoint of immediate procedure upon any suspicion of such an injury, spinal puncture is often helpful in diagnosis, and is best supplemented by roentgen-ray examination of the suspected area in the vertebral column. Treatment of the lesion is virtually limited to rest and symptomatic care. The possible association of intracranial damage is always to be considered. In practice, however, the one hope of improving this rather morbid picture lies in the realm of prophylaxis, through the substitution of gentleness for force in every delivery. One fact, long since recognized in a general way, but emphasized particularly by Crothers and his associates, after a most careful study of an abundant material, is the almost exclusive occurrence of such injuries following breech delivery, whether it be a primary presentation or an extraction after podalic version. The traction frequently essential to delivery in such conditions is characterized as "unphysiological," in that it is necessarily exerted upon the cord, its membranes and its issuing nerve trunks. Whereas Ford's conclusions regarding intracranial injuries leave a reasonable doubt as to the universal culpability of the accoucheur, in the "cord" cases, on the other hand, there is no doubt of that fact, even though the majority of such deliveries may have been conducted under the most skilful auspices. It is pointed out, in summary, that "cord injuries are due to a type of force which can *never* be imposed except during labor."

By way of suggestion regarding prophylaxis, some recommendations of a technical nature may prove helpful. The importance of the performance of external cephalic version

at every opportunity is emphasized, although the unintelligent employment of this maneuver has occasionally been followed by such degrees of twisting of the cord about the child's body as to prevent engagement of the presenting part. Thus, what might have been a simple breech extraction, has required a supplementary version as well. However, such an occurrence is so rare that it should not militate against this valuable maneuver.

In the execution of breech delivery: (*a*) Traction should be maintained in the long axis of the fetus; (*b*) excessive torsion, hyperextension and lateral flexion are avoided wherever possible; (*c*) the body is maintained in a natural posture while the arms are freed, which maneuver should be done by whatever technique and in whatever order requires the least manipulation in the individual case, instead of following slavishly the numerous regulations laid down in some texts; (*d*) pressure is applied suprapubically to the after-coming head, in order to diminish correspondingly the amount of traction upon the shoulders; (*e*) the maintenance of flexion of the head throughout the extraction is a principle so well established as to require no further comment, except to add that it is best insured by a deliberate extraction, thereby permitting the contracting uterus to follow closely the descent of the child; (*f*) the use of forceps to the after-coming head is preferred by many operators, and no criticism is offered if the results are improved thereby; (*g*) thorough manual dilatation of the vagina and perineal floor prior to extraction is of greatest importance, and is recommended as a routine. At this point it should be proper to acknowledge the indebtedness of the profession to Dr. Irving Potter for his illuminating descriptions of the technique of extraction, which come from a wide personal experience; however, credit for the principle of "ironing-out" the perineum goes much further back, and the reader is referred to the earliest editions of Williams' *Textbook of Obstetrics;* (*h*) as a possible alternative to the preceding recommendation,

episiotomy is rational, is preferred by many as a routine, and is especially desirable if haste precludes the possibility of the more conservative "ironing-out" process.

FACIAL PARALYSIS.

Lesions of the facial nerve are divided into those of central and of peripheral origin. The former (supranuclear) affect the tract between its cortical origin and its nucleus in the pons, and are very occasionally seen as a complication of severe cerebral hemorrhage. A central lesion leaves the muscles of the forehead and eyelid unaffected because of their innervation from both hemispheres.

A peripheral injury may be either extracranial or intracranial. The commonest type results from the pressure of forceps blades upon the facial nerve (1) near its emergence from the stylomastoid foramen, or (2) within the parotid gland, although some authors assert that the symptoms are secondary to regional edema, hematoma or simple stretching of the nerve. Such forceps injuries presuppose an asymetrical application of the blades, and thus the opposite side usually escapes, the signs remaining unilateral.

The injury occasionally follows a spontaneous labor wherein (1) an anterior parietal presentation, or (2) an anteflexed uterus in an abnormally lax abdomen allows prolonged pressure during labor upon the mastoid area by the symphyseal portion of the pelvic inlet.

In a basal hemorrhage the nerve may be involved between its emergence from the pons and its entrance into its canal within the temporal bone. Injury within the temporal bone is extremely rare, except as a complication of a serious basal fracture. On the affected side, the eye remains open, the nasolabial fold is smoothed out and the corner of the mouth droops.

Treatment.—Treatment is expectant and, except in rarest instances, function is resumed spontaneously within a few

days. If weakness remains unduly long, electricity is sometimes helpful in restoring the neuro-muscular tonus. The affected eye must be kept clean with scrupulous care. From a prophylactic standpoint, the use of forceps is best restricted to cases clearly indicating their employment, and an instrument should be selected in which the tips of the blades do not squeeze the head too tightly. Finally, the operator's efforts should be directed toward the avoidance of excessive pressure to the sides of the head.

BRACHIAL BIRTH PALSY.

Duchenne first classified the birth paralyses of the upper extremity shortly before Erb's description of the same lesion in the adult, and it has since been best known by the term Erb-Duchenne paralysis. The syndrome was long attributed to a simple pressure injury of roots C_5 and C_6, where they become superficial just above the clavicle and behind the sterno-cleido-mastoid muscle (Erb's point). The possible influence of unrecognized contiguous bony, epiphyseal, or joint injury, and of lesions to the cervical cord, were later considered, while another concept attributes most of the lesions seen to over-stretching or tearing of the nerves through lateral traction. When the damage falls short of an actual rupture of the nerve the perineural sheath may be torn, extravasation of blood follows and the processes of coagulation, healing and scar formation provoke a pressure neuritis or paralysis. Other cases have been shown to depend upon the secondary effects of a localized inflammatory induration.

The pressure of forceps blades over Erb's point accounts for the occasional case following vertex delivery. However, strong lateral traction in the delivery of the shoulders may result similarly. In breech extraction the lesion may follow digital pressure upon, or more commonly, over-stretching of the brachial plexus in delivering the arms, wherein the trauma

may be applied directly by the operator, or may be the indirect result of clavicular compression. Actual rupture of the nerves presupposes a firm fixation of the head or of the shoulders, with violent traction upon the free member, usually in association with excessive rotation. This accident is, fortunately, rare.

The cardinal symptoms of brachial palsy at birth are: (*a*) A limp arm, rotated inward; (*b*) clenched fingers; (*c*) inability to bend the elbow. If, in addition to the usual injury to C_5 and C_6, there is involvement of C_7, C_8 and T_1 or if the whole plexus is torn, the forearm is affected with wrist-drop and flaccid digits. The rare involvement of the forearm alone is known as Klumpke's paralysis.

Injury to the region of the shoulder-joint, especially an epiphyseal separation, often causes the arm to be maintained in a position closely simulating brachial palsy, while the nervous elements may be wholly intact. Roentgen-ray differentiation is difficult because of ill-developed ossification centers, but such a routine examination, particularly if a stereoscopic study is made, often pays. Injuries to the clavicle and cervical spine, or a luetic osteochondritis may be incidentally discovered. Paralyses of central origin are usually associated with the more generalized signs described.

If the nerves are merely pressed upon, or stretched, recovery ordinarily ensues, but permanent palsies result from crushing or tearing. In all cases the possible sequelæ of scarring, inflammation or subluxation of the humerus must be reckoned with.

Treatment.—Expectant treatment suffices for most cases, but with paralysis, the arm should be maintained in abduction, outward rotation and elevation. Gentle massage and manipulation is begun early, and electrical stimulation is employed by some after the fourth week. Open operation directed to the nerve trunks is difficult and often unsatisfactory, because of the scar formation with its attendant

effect upon the nerve tissue. However, muscle atrophy can be combated by tendon transplants, while obvious skeletal traumata may be amenable to orthopedic measures.

MISCELLANEOUS INJURIES.

Marks upon the face may result from abnormal pressure exerted against a pelvic exostosis, or from difficult forceps maneuvers. They rarely leave a scar unless all layers of the dermis are destroyed. Fractures at the base of the nose very occasionally follow the high application of forceps. The mouth injuries almost exclusively follow operative delivery, and have been known to affect the mandible, the tongue and the palate. Delivery of the after-coming head accounts for the majority of such accidents, but forceps blades have been known to fracture the mandible. Trauma to the mucosa of the oral cavity in the course of resuscitation maneuvers has been mentioned previously. Swellings in the parotid may be of traumatic origin (hematoma of the masseter muscle), but these must be differentiated from parotitis (septic, luetic, tuberculous), retention cyst from occlusion of Stenson's duct (inflammation, concretion) and the rare neoplasms of the parotid gland.

Injuries to the eye in the new-born consist chiefly of muscular paralyses, corneal lesions and retinal hemorrhages. The last lesion is particularly common in infants born through contracted pelves, or delivered after a long and difficult labor, although it has been noted frequently after a normal spontaneous delivery. The premature child appears particularly susceptible.

Traumata to the eyelids are reported in greatest variety. Ptosis of the upper lid may follow the simplest forceps extraction and usually clears up promptly (lagophthalmos), but the same sign may follow intracranial hemorrhage, wherein the oculomotor nerve is paralyzed. Edema of the eyelids is often pronounced in a face or brow presentation.

Exophthalmos at birth has been said to signify an injury to the orbit, wherein the retrobulbar veins are distended through pressure exerted at the superior orbital fissure, with or without actual fracture of the surrounding bone. Rupture of these vessels produces retrobulbar hematoma, which leads to exophthalmos unless the blood escapes through the fractured area.

The inability of the infant to perform finely coördinated eye movements has been pointed out, so that transient nystagmus and strabismus are frequent. An occasional established internal squint is far the commonest lesion of the extra-ocular muscles at birth. This is attributed by Ehrenfest, after an examination of the inadequate literature upon the subject, to compression of the abducens in the sphenoidal fissure as it enters the orbit, in the same manner as the retrobulbar veins are traumatized, through oblique pressure upon the calvarium.

Luxation of the eyeball signifies a squeezing of the globus through the palpebral fissure, followed by the tight contraction of the lids behind it. Replacement has been successful with the aid of external canthotomy. *Avulsion*, on the contrary, means a complete separation of the eyeball from the orbit, which almost always occurs after misdirected operative delivery, and occasionally after severe orbital fracture with hematoma. Completion of the enucleation is the only rational procedure.

Birth injuries of the cornea, except the most transient types, usually result in a diffuse or striate opacity. The results of improper application of silver nitrate have been mentioned. Corneal opacities most often follow edema and infiltration, and may appear subsequent to severe injuries to contiguous structures (fracture of the orbit, tears in Descemet's membrane) or to direct forceps pressure. Very rarely a traumatic cataract is similarly produced.

Hemorrhage into the anterior chamber may follow any of the agencies mentioned, but has been observed as well in

normally delivered infants, in whom venous congestion has been extreme at birth; for example, in cases of tight strangulation of the neck by the umbilical cord.

Retinal hemorrhages are present, often in both eyes, in a large percentage of new-born infants, and particularly among the premature, the still-born or those who succumb within the first few days. Further predisposing factors are syphilis and the hemorrhagic diathesis, and while the exciting causes are not strictly established, the freshness of the extravasation tends to indicate that it is a natal rather than a prenatal phenomenon. Until a better explanation is forthcoming, it must be regarded as a "congestive" reaction. Instances of optic atrophy have been attributed to parturitional traumata, but the origin of the lesion is rarely clear cut.

Superficial tissues of the neck may be injured by: (*a*) The tips of forceps blades, especially in extended head (face) presentations; (*b*) after ill-advised traction upon the neck in delivery; and (*c*) in the occasional case of infanticide by strangulation. Loops of cord about the neck of a live child do not leave an impression upon the skin, but when strangulation is deliberate furrows or associated signs of trauma by the fingers may be evident. The water test upon the lungs may be used here to advantage.

Sterno-cleido-mastoid hematoma represents an extravasation into the sheath surrounding this muscle, and it is caused by vascular rupture from excessive stretching or rotation of the head. The area of extravasation is quite limited by the surrounding tissues, and such hematomata frequently present an extremely firm and sensitive induration. The chin commonly tends to rotate away from the affected side, while the head is drawn toward the lesion. Spontaneous resorption without contracture is the rule, and operative interference is contraindicated unless secondary infection complicates the picture. The condition of congenital wry-neck (caput obstipum) is thought to be a preformed lesion *in utero,* wherein abnormal pressure forces

cause a slow fibrous degeneration, with scarring and contraction. Such a lesion is doubtless more often the cause than the result of breech presentation, but muscle tissue of this character is likewise more susceptible to operative injury, and this doubtless underlies many of the hematomata encountered.

A brief summary of the commonest injuries to the longer bones does not include those occasionally sustained through violent maternal injury in the latter months of pregnancy, nor those dependent upon imperfect ossification, which is discussed elsewhere.

The majority of clavicular fractures doubtless escape notice, but their frequent occurrence is well established. During extraction of the after-coming head, the bone may be broken by the operator's fingers as they are applied over the shoulders, while strong pressure in bringing down the arm is likely to be transmitted through the humerus to the clavicle, with subsequent fracture. The same injury is not uncommon in vertex presentations, even in spontaneous delivery, because of prolonged pressure of the anterior shoulder upon the symphysis, often in combination with an upward thrust of the posterior shoulder by the perineum.

Dislocation of the fragments, crepitus and hematomata are rare, while signs of weakness and pain are variable, depending often upon the presence of an associated injury to the brachial plexus. Roentgen-ray examination usually shows a green-stick, oblique or subperiosteal fracture; more rarely, a simple transverse type. Callus forms early and is quickly absorbed.

The prognosis is always good, and the part requires immobilization only in marked displacement of the fragments. One author even emphasizes the irritative effects of the average immobilization device, contrasted with its questionable orthopedic value.

Injuries to the humerus consist chiefly of luxation at the shoulder, epiphyseal detachment and fractures of the diaphy-

sis. The elbow and forearm are rarely injured, but separation of the lower epiphysis of the humerus may simulate such an injury. Fracture is oftenest sustained in breech extraction in the course of releasing and delivering the arms; and while in vertex presentations it is much less common than clavicular injury, it has been known to occur, and presumably by a similar mechanism. Inward rotation of the arm is commonly seen, but the signs of fracture are often difficult to demonstrate in the less pronounced cases, except by roentgen-ray. Callus formation is usually prompt and abundant. Fixation is indicated only in the most serious cases, with displacement. Associated trauma to the nerves is an occasional complication, requiring independent treatment by massage, stimulation, or at times by surgery, when nerve trunks become involved in scar tissue.

The thorax is rarely traumatized in delivery, but instances of injury to the lung and fractured ribs are recorded as a sequel to violent resuscitation devices. Tearing of the muscle fibers attached to the thorax has been noted, most commonly involving the lower strands of the trapezius, and creating the so-called "congenital" high shoulder.

Abdominal "birth" injuries are ultimately explained by: (*a*) Intentional traumata incident to infanticide; (*b*) postmortem changes; (*c*) strictly natal traumata; (*d*) neonatal injuries incident to such measures as "swinging" for asphyxia, which have been believed to be solely responsible for lacerations of the liver, spleen, adrenals and pancreas; and (*e*) as a bleeding manifestation of syphilis or sepsis.

In the course of any delivery the blood is concentrated in the portion of the fetus as yet unborn through the vulvar ring. The susceptibility of the liver, spleen, pancreas, adrenals and kidney to hemorrhage in the course of breech extractions is, therefore, evident. The possibility of visceral rupture then varies with vascular fragility, prematurity, asphyxia, predeveloped vascular and parenchymatous congestion or disease, and trauma in delivery and resuscitation.

Some authorities hold, however, that congestive hemorrhages as shown by capillary ecchymoses are rarely serious from the standpoint of blood loss, and that tissue destruction is unusual unless a larger vessel is affected.

The liver frequently shows surface ecchymoses even after mild grades of asphyxia, alone. Hemorrhages beneath the capsule are less common, but frequently follow breech extractions. Lacerations may be superficial, involving the capsule only, or may be deep in the parenchyma. In the latter case death is characteristically delayed (two to three days), but sudden, upon the escape of a sufficient amount of blood into the peritoneal cavity.

Variable degrees of medullary hemorrhage into the suprarenal glands, followed by pressure necrosis of the cortex, are described. Severe hemorrhages appear most frequently to follow difficult extractions, prolonged labor and asphyxia, but the lesion is not wholly explainable on this basis. Death usually occurs early, and the violent associated symptoms have been attributed by some to an adrenalin intoxication. If the hematoma is not palpable diagnosis is difficult.

Splenic rupture is said to follow preëxisting disease of the organ, for example, syphilis. The pancreas and kidneys are rarely involved in a simple birth injury. The few recorded instances of trauma to the intestines assume a preëxisting distention followed by rupture, incident to the forces of labor. The normal bladder and uterus are practically never injured in labor, and the same is true of the testes, except for the possible consequences of long-continued congestion of the scrotum in frank breech presentations. The perineal body of female infants has been lacerated in all degrees by forcible efforts at extraction, and in the rarer cases of artificial dilatation of a presenting anus, mistaken for the maternal cervix.

Similarly, the awkward use of Smellie's blunt hook or of the forceps to the impacted breech have often resulted in serious damage to the bones and soft tissues involved.

The lower extremities appear to be predisposed to the

intra-uterine bone diseases, *i. e.*, osteogenesis imperfecta, but the majority of fractured femora are sustained in the course of an internal podalic version or a breech extraction. This possibility is minimized by proper grasping of the foot (or preferably both feet) instead of the thigh; by avoiding any crossing of the legs in the intra-uterine maneuvers; by securing the best possible uterine relaxation through the utilization of the maximum available amount of amniotic fluid for the turning; and by deep anesthesia. During the delivery excessive traction or a very tight grip on the thighs may produce femoral fracture, the danger of which can be lessened by manipulating the delivered portion of the body through a sterile towel. The production of fracture with the older instrumental methods of releasing the impacted breech is less frequently observed today.

Fractures usually occur in the upper third of the femur, with outward displacement of the upper fragment. Prompt and radical immobilization with traction, according to some authors, is essential for the prevention of deformity and shortening. Dislocation of the hip is almost always a true congenital deformity, of intra-uterine origin. Epiphyseal separation at the head of the femur only follows violent traction in combination with rotation or forced abduction.

Injuries to the leg and foot are very sparsely mentioned in the literature; more frequently isolated palsies of the lower extremities are described.

CHAPTER X.

INFECTIONS.

Almost equal in importance to the problems arising from the infant's adjustment to extra-uterine digestive processes is the matter of infection. The majority of such lesions are localized, but the more general types are still encountered, despite great improvements in aseptic technique.

Although the susceptibility of the new-born to many infectious processes is well recognized, yet it possesses an apparent immunity to other infectious stimuli (measles, scarlatina, etc.). The source of this immunity has called forth a large number of investigations, which have thrown considerable light upon the problem.

(*a*) Hereditary transmission of predeveloped immune bodies from the parents to the fetal germ plasm appears to be ruled out.

(*b*) Active immunization of the fetus *in utero* by specific agents applied to the mother does not provoke the immunity, doubtless because of the impermeability of the placenta to the large molecules involved.

(*c*) Passive immunization by transmission of preformed maternal antibodies has been claimed for some antitoxins, agglutinins, hemolysins and precipitins; but experiments with tetanus, diphtheria and typhoid have proven negative. The results are inconclusive regarding the transmission of such bodies through the placenta, and the facts adduced so far admit no generalities concerning this function. Again, in the course of such experiments, the figures upon the relative antibody titre in the mother's and the child's sera are in conflict.

(*d*) The remaining possibility, that of the transmission of antibodies through the colostrum and milk, has intrigued many workers since the original studies of Ehrlich, and some evidence has been obtained in favor of such a transfer, or stimulus, in spite of the inert bactericidal character of the milk. Further attempts to correlate immunity production with the combined effect of breast milk and preformed complement in the fetal organism have not shown a constant relationship, and the latest available conclusion is that the infant is only partially, if at all, dependent upon the mother for the development of natural immunity, but, on the other hand, that antibodies are formed as a part of the natural growth processes of the child.

ACUTE INFECTIONS.

Morbilli.—Most mothers are immune to measles, but when the disease occurs during pregnancy it may be transmitted to the child *in utero*. This does not necessarily follow, but indubitable instances of a fully developed eruption in the infant at birth have been reported. Between the extremes of an eruption in the fetal state and a complete escape from the disease there are many records of a delayed eruption. In such cases infection from extra-maternal sources is not considered likely by most authorities. On the contrary, the new-born generally appears to possess an immunity which is ordinarily effective up to the second month of life.

Scarlatina.—Scarlatina is rarely seen under four months of age, and many of the cases of scarlatinoid eruptions in early infancy are doubtless attributable to agents other than the streptococcus of scarlet fever.

Diphtheria.—The natural immunity of the new-born to diphtheritic infection has been confirmed by the consistently negative intracutaneous reaction to diphtheria toxin. Occasional membranous reactions in the naso-pharynx particularly, including the tonsils, palate and oral membranes, have shown

an association with a diphtheroid bacillus which has often proven misleading. Although true diphtheria is rare in early infancy, such findings should be followed by the administration of antitoxin in a minimal dosage of 150 units.

Variola (Smallpox).—Intra-uterine transmission of this disease has been observed both in the acute form and in healed lesions at birth, but such observations are uncommon at present because of the rarity of epidemic smallpox, plus the tendency to abortion upon the acquisition of the disease. There is no constant relationship between the severity of the disease in the mother and the infant, and the full-blown picture may be present in one without comparable, if any, involvement in the other. Vaccination in the new-born is not attended by the same reaction as in the adult, either local, glandular or constitutional; therefore, its employment is safe whenever it appears indicated. Failure of successful vaccination is frequently noted, and this fact is not explainable except in so far as it is noted that such failures most often appear in the children of mothers who are actively or passively immune.

Varicella (Chickenpox).—This disease is extremely rare in the first month of life, doubtless due to the relatively long incubation period of two to three weeks. A few cases have been reported from large infectious disease clinics.

Pertussis.—Pertussis is practically never seen prior to the second week, and rarely during the first month, but, as in the other acute infectious diseases, the child should be reasonably protected by isolation, and if the mother is affected the nursing program should be modified.

Influenza.—Influenza is not common to the new-born infant, but the tendency to a catarrhal rhinitis is very marked, and its occurrence and development should be prevented by every reasonable means.

Typhoid Fever.—Typhoid fever in the mother has been followed by fatal illness in the new-born child, wherein typhoid bacilli have been cultivated from the infant's blood.

On the other hand, when the child escapes the disease it is attributed to protective agglutinins transmitted from the mother, particularly when the disease has occurred in the latter half of pregnancy.

Tetanus.—Tetanus was once the greatest single cause of infant death. Its occurrence in the larger clinics, as well as among the slaves of the South, was appalling. Today it is almost a curiosity, due particularly to the careful management of the umbilical cord as well as to the elimination of dirt from the lying-in quarters. However, in the backward districts of the world the disease is still rampant. Tetanus infection in the new-born is favored by the local conditions present at the umbilicus, a fresh wound in proximity with the degenerating cord stump, whence the toxins traverse the motor neurone paths to the cord and medulla. It is to be noted, however, that many cases of generalized tetanus have been reported without local evidences of infection at the umbilicus. The symptoms of spasm, affecting first the muscles of mastication, then of the face and, finally, of the trunk and extremities, appear most commonly in the second week, although cases are reported both earlier and at a later date. Opisthotonus is the usual concomitant of the late stages of muscle involvement. The spasms are intermittent, but are likely to be increased in severity and frequency by all sensory stimuli. Fever is variable, often reaching excessive heights, and is intermittent in type. The pulse is rapid and thready.

Simple and mild cases, treated early, and amenable to feeding, offer a fair prognosis, but the mortality remains extremely high. It is estimated as high as 98 per cent by some authors, although others report better results. Death ordinarily follows within one or two days after the symptoms become fully developed.

Treatment.—The cardinal principles of treatment consist in the early administration of serum, both subcutaneously and intrathecally. Specific treatment is ineffectual after the toxins have attacked the nerve centers, but the effect upon

the uncombined circulating toxin is marked. The injections may be repeated daily if improvement is noted. Secondly, control of the spasms by sedatives is rational and is best accomplished by chloral hydrate per rectum, in combination with chloroform inhalations, when necessary. Forced fluid is indicated by whatever route can be employed to advantage in the individual case, and feeding is best accomplished by nasal catheter. Aseptic treatment of the cord and umbilicus from the time of birth to that of complete healing is the single effective prophylactic measure.

CHRONIC INFECTIONS.

Tuberculosis.—*Congenital* tuberculosis, wherein the lesions are preformed in the organs of the new-born from a transplacental source, is extremely rare, and is only supposed to occur in the wake of a generalized maternal infection associated with a mechanical defect in the placental barrier. Such a placental alteration is usually tuberculous in itself. The rarity of the disease is further accounted for by the large number of women who are sterile under such conditions, who abort in early pregnancy, or upon whom therapeutic abortion is carried out. *Hereditary* tuberculosis is classified as the type wherein a child is born infected but without demonstrable organic signs of the disease.

Such cases ordinarily show symptoms at a much later period of infancy, in contrast to the congenital type, where very advanced lesions involving the lungs, lymphatic glands or even bone may be present at birth.

The acquired lesion usually begins in the respiratory tract from inhalation of the organisms, or more rarely starts in the digestive tract.

Although many tuberculous women may bear normal non-infected children, it is of extreme importance to effect early and complete isolation of the child, particularly if the

mother presents an active lesion. In any event the precautions against contact infection must be very complete.

Tubercle bacilli have been cultivated repeatedly from the milk of nursing mothers, so that assimilation tuberculosis of the infant doubtless occurs, but the contraindication to nursing is based particularly upon the great likelihood of infection by way of the respiratory tract. Moreover, the mother herself should be thus relieved of the added strain of nursing.

Syphilis.—In certain localities congenital syphilis is still very common, but published records show a considerable decrease in its incidence, directly attributable to its early recognition and vigorous treatment in the course of prenatal care. This chapter in preventive medicine has not only proven valuable in the increased numbers of live-born and healthy children among infected parents, but it has been shown that during pregnancy the mother is peculiarly susceptible to antiluetic therapy, so that its institution carries a two-fold benefit.

In contrast to tuberculosis, syphilis is almost always congenital in the new-born and, also, unlike tuberculosis, it may develop with little or no demonstrable evidence of maternal disease. On this account, the existence of a maternal immunity is presupposed, which has long been known as Colles' law. Many theories for and against the latter assertion have been exhibited, but the scope of this summary hardly admits their review, except to note that a strictly paternal origin of the disease is probable in certain cases.

It is an axiom of obstetrics that, without vigorous antenatal treatment, syphilis is the greatest single cause of prematurity and still-birth, presumably from toxic effects, circulatory changes, or both. Moreover, many infants are born infected (hereditary type) and show specific lesions only at a later date, usually at four to eight weeks of age. Such cases frequently show a negative Wassermann reaction, which later becomes positive. It is also of interest to note that in a series of syphilitic children of the same parentage

there tends to be a progressively diminishing virulence with each successive pregnancy, as is manifested by a correspondingly lessened tendency toward prematurity, still-birth and maceration.

The diagnosis of syphilis in the new-born may be difficult to make, for the protean character of the signs is as striking as in adult life. Attention is most often directed toward syphilis through its skin manifestations. Rhagades, or fresh abrasions radiating from the corners of the mouth are commonly seen. The palms and soles may show excessive cracking, blistering and scaling, along with a coppery discoloration, although it is unwise to draw conclusions solely from the finer alterations of color because of the reddish-blue tinge of ordinary venous congestion plus the icteric changes of early infancy. The generalized luetic skin changes are most often suggestive of pemphigus, but the vesicles contain a fluid described as turbid or milky, rather than purulent, while the edges are infiltrated and the base of the lesion is of a brownish-red color. The maculo-papular syphilide is less common. Any part of the body may be involved, but pemphigoid involvement of the palms and soles is highly indicative of the etiology.

Rhinitis is the commonest reaction in the mucous membranes and, although it may be delayed, it is usually apparent not later than the fourth week. The attendant muco-purulent or blood-streaked discharge causes the "snuffles" and irritation of the surrounding skin about the nares.

General glandular swellings in congenital syphilis are comparatively rare, and the presence of palpable epitrochlears is the only helpful sign in this regard.

Many infants dying of congenital syphilis present pneumonic changes in the lungs which are commonly of the simple type; but a "white pneumonia" is described and attributed to infiltration of the interstitial tissue, proliferation of the vascular intima and exudation into the alveoli.

Hemorrhage in association with syphilis usually implies a

coëxisting hemorrhagic disease or sepsis; but the spirochete commonly attacks smaller vessels, giving rise to coagulation necroses, bloody exudates or actual vascular rupture.

An inflammatory reaction in the connective tissue cells of the liver causes an enlargement and induration of the organ and, although the sign is not pathognomonic of the disease, it is a very constant association, doubtless because of its location in the direct path of the umbilical vein. Secondary involvement of the bile ducts may be followed by icterus, but this is a rarer complication. Associated enlargement of the spleen is a helpful sign, and in the absence of sepsis has practically no other etiology in early infancy.

Kidney changes in syphilis are generally microscopic and, although all types of nephritis are described, the commonest is an interstitial lesion wherein the connective tissue elements, particularly of the vessels, are affected by a pronounced round-cell infiltration. Parenchymatous nephritis is rare in infancy under all conditions, despite the regular appearance of transient albuminuria. Luetic changes in the central nervous system of the infant differ from the adult reaction. In contrast to a fibrous degenerative process, the lesion is of the acute inflammatory type, involving chiefly the pia mater in a proliferation of lymphocytic exudate, often in association with occasional small hemorrhages or abscesses of the cortex. Symptoms referable to this lesion are inconstant, but meningeal irritation may be present. The spinal fluid may or may not show complement-fixation for syphilis, but the demonstration of spirochetes is said to be relatively common and is conclusive of the diagnosis. The cytology and globulin content of the spinal fluid serve only as corroborative evidences of the disease.

In the eye spirochetes have been demonstrated in many foci, the commonest of which are the optic nerve and retina, presumably an extension from the meningeal involvement higher up. Optic neuritis is associated with a cloudy disc with or without spotty deposition or pigmentation of the

retina. Interstitial keratitis is another common manifestation of fetal syphilis, and is explained as a direct extension from an initial involvement of the choroid.

Syphilis of the bony skeleton takes the form of a characteristic osteochondritis involving the junctions of the epiphyses and diaphyses of the long bones and ribs (Wegner's bone disease.) The line of preliminary calcification is widened and irregular, with spongy interstices, in contrast to the narrow straight line of junction in the normal bone. Although such changes are usually confirmed only by roentgen-ray or at autopsy, an associated periostitis or complete separation of the epiphysis may so interfere with the use of the extremities that a pseudo-paralysis (Parrot's) may be manifest. Degenerative changes in the muscles may ensue, but joint manifestations are very rare.

Latent syphilis or its retarded appearance may be explained by a recently acquired infection, at birth for example. Likewise, Profeta's law claims an immunity in the child to parental syphilis in certain cases, particularly among those in which the maternal infection was acquired in the postconceptional period. This theory, however, has met with great opposition and no little contrary evidence has been adduced against it.

These discrepancies, associated with the well-established fact that the Wassermann reaction of the new-born is a very unreliable index of luetic infection, render imperative the routine study of the placenta in all cases. Syphilis of the placenta is characterized by an unmistakable microscopic lesion, which frequently affords the best available criterion of the disease in pregnancy. Upon its discovery, the child should receive antiluetic treatment, regardless of associated findings and factors.

Even in the absence of the more specific lesions mentioned, any case of underdevelopment, unexplained fever, nutritional difficulty and unusual susceptibility to the ordinary infections may point to an underlying syphilis, which calls for vigorous, early treatment.

Establishment of a rational nursing régime in syphilitic cases is rendered complex by the disagreement over the life history of the infection, particularly concerning Colles' law—that a healthy mother of a luetic child may be immune; and Profeta's law—that a healthy and immune child may be born to a luetic mother. Remembering the importance of breast feeding in any case, a reasonable attitude toward the problem might be reduced to the following:

(*a*) Mother and child syphilitic; nursing urged.

(*b*) Mother asymptomatic, Wassermann positive, child Wassermann positive; nursing permissible.

(*c*) Mother asymptomatic, Wassermann negative, child Wassermann positive; nursing may be practised with impunity, according to Colles' law, but it is imperative to remember that this child may infect other women than its own mother, which again stresses the urgency of a blood test preliminary to any wet-nursing program.

(*d*) Mother luetic, child healthy, Wassermann negative; nursing contraindicated (through numerous observed exceptions to Profeta's law).

(*e*) Mother luetic, child healthy, with signs of latent syphilis, regardless of Wassermann reaction; nursing permissible if mother presents no open lesions.

Milk from mothers with latent syphilis is regarded as safe, particularly if the Wassermann reaction is negative, but other devices than direct nursing at the breast are desirable alternatives.

Congenital syphilis is so often attended by widespread parenchymatous lesions that the prognosis is generally bad. Only the cutaneous manifestations yield well to treatment. Clearly recognized syphilis or a positive blood reaction calls for immediate treatment in all cases. Inunctions or injection of mercurials in weak concentration are used as adjuncts, or as alternatives to the arsenicals, the details of whose administration are invariably best consigned to the trained pediatrician or syphilologist, not only because of the technical

dexterity required, but also to gain the benefit of experience in the constantly changing modifications of treatment. Pending this it has long been the practice in certain obstetrical clinics to apply mercurial ointment continuously beneath the abdominal binder in any case of suspected syphilis.

Sepsis.—The term sepsis generally includes those pyogenic diseases which are complicated by a blood-stream infection (septicemia or bacteriemia), but frequently a localized lesion of the same etiology is called by that name, because of the similarity in the constitutional reaction from the absorbed toxins (toxemia). Metastatic abscesses are further differentiated by the term pyemia. Sepsis thus remains a diffuse concept in contradistinction to the specific infections, but this comes about through the multiplicity of the causative organisms, plus the numerous possible portals of entry, with their inevitable variations in response. The organisms concerned belong predominantly to the streptococcus-staphylococcus group and, rarely, the gonococcus.

Sepsis may occur *in utero* through upward transmission of bacteria, and thence across the amnion and placenta into the fetal circulation, particularly in cases of prematurely ruptured membranes, prolonged labor and frequent or unclean vaginal examinations or operative maneuvers. The direct connection between the placental end vessels of the fetus, and the umbilical area with its contiguous peritoneum and its strict continuity with the general vascular system of the child, offers every opportunity for the development of this type of infection.

Direct transmission of bacteria from the maternal blood stream may follow placental injury, but instances of fetal toxemia alone or retarded nutrition from similar causes are not so classified. Isolated instances of infection from the peritoneum by way of the tubes and across the fetal membranes to the amniotic fluid have been reported. Such cases have followed acute infections of the appendix.

During birth the commonest foci of infection are those

resulting from aspiration and those beginning at the umbilicus, although the latter type is becoming progressively rarer. These organisms may be picked up from the amniotic fluid, from the vagina or from purely exogenous sources, postpartum.

The skin is important as a portal of entry and small abrasions may permit the ingress of organisms responsible for the severest cases of sepsis, as well as those producing the more benign skin reactions. Next in frequency and importance are the mucous membranes of the mouth and its adjacent glands, the naso-pharynx and the middle ear, whence sepsis may ensue by way of the meninges. The great liability of bronchial and pulmonary infection carries over into the early days of extra-uterine existence. Some authors attach great importance to enterogenous infections and seek to explain not only the suppurations of hematomata, fractures and umbilical stumps, but even melena and icterus upon the basis of a septicemia of such an origin. Toxemic states having a similar source might well serve to complicate this explanation of sepsis.

In any event the degree of natural immunity against such infection is known to be slight, and the absence of lymphatic gland reactions to all infectious processes of infancy serves to confirm the former observation.

When bacterial infection becomes generalized there is rapid wasting due to intolerance of food and loss of water through vomiting and diarrhea, along with the excessive tissue destruction. There may be evidences of extreme distress or a complete apathy may occur. The skin tends toward an ashen color, except as a coincident icterus may alter the picture. Exanthemata are unusual, except in the form of superficial hemorrhages. Abscesses and areas of cellulitis may represent either the cause or the effect of sepsis. Fever is a variable sign, showing extreme elevations in some instances, while others will show no febrile reaction in the presence of proven bacterial invasion. Rarely there are

signs of irritation in the nervous system, due either to existing infection (meningitis, encephalitis) or to a purely toxic effect. In addition to the frequent localization of infections in the respiratory tract (rhinitis, bronchitis, pneumonia), the breathing itself is often affected by general sepsis, evidenced by changes in rate or even in dyspnea. The digestive tract is often involved secondarily with vomiting and diarrhea, thus contributing to the dehydration mentioned. Hemorrhage into the digestive tract may be seen in association with generalized visceral bleeding, but is further differentiated from essential hemorrhage by its later appearance, usually in the second week. An acute splenic tumor is often seen; albuminuria is inconstant.

Considering the multiplicity of signs, and remembering that many of the stigmata of sepsis are often simulated by less severe lesions, it is often as difficult to confirm as to exclude it. Blood cultures are probably the most helpful diagnostic criterion.

The prognosis varies directly with the severity and the duration of the symptoms, as well as with the virulence of the bacteria concerned, which is another way of saying "with the degree of parenchymatous destruction."

Treatment.—In addition to nutritive and fluid considerations, the treatment is supportive by stimulants, sponges and symptomatic therapy. Transfusions, frequently repeated, are productive of good results. Intravenous germicides have occasionally been attended with brilliant cures, but the results are generally unsatisfactory. Serums are very disappointing.

Sepsis today is negligible compared with its incidence in previous generations. This is attributable to more refined prenatal care, improved methods in the conduct of labor, the introduction of the "aseptic" program to the nursery, early recognition of disease, prompt isolation of infectious lesions, more rational feeding practices and intelligent daily routine care.

CHAPTER XI.

DISORDERS OF SPECIAL SYSTEMS.

RESPIRATORY SYSTEM.

Atelectasis.—The lungs at birth are collapsed and relatively "solid." The first respirations serve to expand a relatively small area of them, and the process only becomes completed after several days of extra-uterine life. The tissues about the hylus or the posterior parts of the lower lobes are normally the last areas to react, in spite of the fact that diaphragmatic breathing predominates during the first few days. Atelectasis is defined as the persistence of the fetal state, wholly or in part, but since this is a normal sequence the designation is given only when the condition is *symptom-bearing.*

Symptoms.—These signs are most frequently seen in the premature or feeble infant in whom the normal pulmonary excursions are limited by the child's debility. It may also follow any type of asphyxia, tending to be most pronounced as an accompaniment of organic trauma.

The respirations are shallow and rapid, with occasional periods of apnea at first, and the depth and duration of the cyanosis constitute a fair index of the pulmonary status. The cry is unsatisfactory and infrequent except with stimulation. The temperature tends to be subnormal, necessitating the external application of heat, while convulsions occasionally ensue. The severity of the symptoms is variable, with frequent intervals of relapse, which in favorable cases become less frequent and prolonged as the lungs assume their normal function.

Diagnosis.—The diagnosis of atelectasis can be confirmed by the physical findings of consolidation, plus the roentgen-ray picture, when necessary. The importance of recognizing

the atelectatic lung is increased through the susceptibility of such tissue to pneumonic infection.

Treatment.—The treatment, after overcoming the initial asphyxia, consists: (1) In frequent stimulation to induce crying, which favors further expansion by the deeper respirations created; and (2) in the continuous administration of oxygen and carbon dioxide through a nasal tube, which delivers the gas to the naso-pharynx and so alters the inspired air. Frequent change of position is recommended, and in case of an acute relapse tubbing may be repeated. Cardiac and respiratory stimulation by hypodermic may be added as indicated by the case.

Cyanosis.—Cyanosis in the new-born calls for a consideration of other possible etiological factors in addition to simple atelectasis:

(*a*) *Congenital heart disease* is frequently attended by inadequate aëration of the blood as a result of a disordered lesser circulation. Auscultation usually reveals the characteristic murmurs of valvular incompetence.

(*b*) *Intracranial hemorrhage* is frequently the sole cause in the presence of an anatomically functional respiratory tract.

(*c*) An *enlarged thymus* has been thought by some to encroach so greatly upon the trachea, the large vessels and the space normally given to lung expansion, that cyanosis follows. In rare instances there are no symptoms referable to the thymus at birth, but sudden death from acute edema or hemorrhage into the gland may follow later. An enlarged thymus can rarely be percussed with accuracy, but the roentgen-ray clearly outlines any hypertrophy, while the same agent constitutes a specific treatment, when administered in small dosage at fairly long intervals. On the other hand, an enlarged thymus may cause death before the effects of roentgen-ray treatment can be felt (thymic stridor).

(*d*) *Diaphragmatic hernia* has been discussed as to occurrence, recognition and prognosis. This, fortunately, is a rare complication.

(*e*) *Aspiration*—usually of mucus or amniotic fluid—is characterized by an inspiratory wheeze, a "bubbling" expiration, or both. This is correctable by placing the head in a dependent posture in order to promote drainage, while the fluid which escapes to the pharynx may be removed by suction or by "tracheo-laryngeal" massage outward.

(*f*) The occurrence of exudate in the serous cavities or of congenital hemorrhage into the pulmonary parenchyma may be mentioned as more remote possibilities. Congenital malformations and neoplasms are responsible in very rare instances.

Congenital stridor is characterized by a crowing inspiration, which has to be differentiated from that occurring in simple laryngeal spasm, pertussis, diphtheria and the very rare congenital goiter. It appears to depend upon a diminution in the normal capacity of the larynx, although a functional disturbance of the neuro-muscular mechanism is held to be the cause by some authors. Cyanosis is unusual except with increased excitement. The symptom appears very early and tends toward spontaneous correction within the first year, as the larynx develops. The occasional severe case calls for intubation or tracheotomy, but the liability of respiratory infection always complicates the treatment.

Congenital goiter, or large teratomata arising in the same area, are obvious upon inspection, and the immediate problem lies in the prevention of dyspnea. Respiration can be aided by a slight backward bending of the head, accomplished by supporting the back of the neck with a small cushion. Operative interference is usually necessary, although lesser degrees of simple thyroid enlargement may be treated from the beginning with small doses of iodides.

Simple infections of the upper respiratory tract are occasionally seen in infancy, but an early rhinitis always suggests congenital syphilis. Difficulty in maintaining normal respiration during nursing is often the first sign of the lesion, so that bottle or tube feeding, preferably with breast milk, will

be required occasionally. Nasal applications of medicated ointments, antiseptics and astringents, must be used with caution, in view of the liability of secondary middle-ear infection. An associated inflammatory swelling of the adenoid tissue is more commonly seen than involvement of the tonsil.

Pneumonia.—True congenital pneumonia, clearly acquired *in utero*, has been described, but a primary pneumonic lesion in the new-born is more often due: (1) To aspiration of infectious material in the first days of life (aspirated food or vomitus); (2) to air-borne organisms or droplet infection; and (3) more rarely, to an infection acquired during labor from contaminated amniotic fluid, or from vaginal bacteria.

Pneumonia may be secondary, metastatic or embolic. In either case the atelectatic state favors development of infection, and may render the physical signs difficult to interpret. The outcome depends upon the microörganism involved, the extent of the infection, as well as upon the constitution of the individual child. The lesion is not easily recognized, but is suggested by a high respiratory-rate and an otherwise unexplained cyanosis. In addition to the thoracic signs, gastro-intestinal reactions may be very violent and confuse the picture. Pleural effusion or empyema occasionally ensue, and are most often due to the streptococcus. The prognosis in such an event is extremely serious.

CIRCULATORY SYSTEM.

Dextrocardia with or without situs transversus is reasonably frequent and is without serious significance, but major degrees of displacement (ectopia cordis) are uniformly and promptly fatal. Problems of cardiac hypertrophy are practically never present in the new-born, except as they may be simulated by temporary dilatation of the right side, in association with asphyxia.

Valvular disease of the heart is practically always a matter of maldevelopment, in contrast to the inflammatory lesions of later childhood. The cardinal signs are cyanosis, usually associated with a cardiac murmur, both of which are persistent. One sign may predominate, and either may fluctuate in intensity, while the lesion may occasionally exist with very little immediate symptomatology. There is frequently an increased pulse- and respiratory-rate, depressed temperature and polycythemia.

The depth and the course of the cyanosis is looked upon as the best index of the ultimate outcome, and little more than symptomatic measures are available for treatment.

The commonest types of congenital heart lesions are variously classified, but differentiation *in vivo* is always difficult. The finer variations are chiefly of interest to the pathologist; but since the larger types carry a varying prognostic significance, a brief résumé is appended:

(*a*) *Patent septum* is one of the commoner lesions, and the prognosis is ordinarily good. Murmurs are variable in type; in fact, they are often absent. Cyanosis is unusual.

(*b*) *Patent foramen ovale* is frequently seen as a persistent fetal condition. With a tendency to spontaneous closure, the prognosis is good, if unassociated with other cardiac abnormalities.

(*c*) *Pulmonary stenosis* is frequent, but of variable severity. A pulmonic systolic murmur is heard, along with a diminished intensity of the second sound. Cyanosis is variable, but is likely to be severe. The lesion is usually associated with other malformations, which render the physical signs variable and the prognosis grave.

(*d*) *Aortic stenosis* is much less common. The auscultatory signs vary with the functional capacity of the foramen ovale and ductus arteriosus. The lesion carries a very serious prognosis.

(*e*) *Patent ductus arteriosus* is usually accompanied by a humming continuous murmur, with or without cyanosis,

depending upon associated cardiac anomalies. The prognosis is good in uncomplicated cases.

Disturbances of cardiac conduction have been observed in the new-born, but they are ordinarily self-limited and without importance. Changes in the cardiac mechanism appear to result occasionally from a purulent pericarditis. The peripheral vessels are subject occasionally to septic thrombosis and to the vascular lesions of syphilis, which have been mentioned.

HEMATOPOIETIC SYSTEM.

Spontaneous Hemorrhage is usually termed "hemorrhagic disease of the new-born," and it occurs about once in 200 cases, in greater or less severity. The sex incidence is about equal, and it appears unrelated to hemophilia, although the disease somewhat resembles the purpuras of later life.

The constant blood characteristics are: (1) Prolonged bleeding- and coagulation-time; and (2) a decrease in the number of platelets. The signs predominate, as a rule, in the digestive tract, and consist in blood-stained vomitus, characteristic tarry stools, or even the escape of bright red blood from the bowel. Intestinal signs are more frequent and constant than gastric. Bleeding may develop in the skin, either spontaneously or as a result of pressure. The points of predilection are: (1) The mucous membranes, particularly of the conjunctivæ, the naso-pharynx, the mouth and the female genital tract; (2) the serous cavities; or (3) the viscera. Occasionally, persistent bleeding from the cord or umbilical stump is the first sign, or, more rarely, hematuria.

Fever is variable, but icterus occurs frequently in severe cases. In the most advanced types, anemia and prostration, altered respirations, cyanosis and convulsions may appear. The onset may be early or late, but usually it begins during the first week, and is progressive in the absence of treatment.

Melena vera is a symptom due to bleeding originating within the gastro-intestinal tract, in contrast to the tarry

stools resulting from swallowed blood, derived from the vagina during labor, or incidental to cranial injuries communicating with the pharynx or to bleeding nipples. True melena is usually copious in amount, as contrasted with other types of intestinal hemorrhage. It begins most often in the "meconium" stage, and the stools tend to be black rather than green, often with a red border upon the diaper. The odor is "bloody" rather than sour, as in the case of the breast-milk stool. The movements are increased in number, and at times blood alone may trickle from the anus.

Variable degrees of anemia are observed and, to a lesser extent, jaundice may accompany the picture. At times an unexplained fever is associated with the disease, but in the wake of severe anemia the temperature may be depressed. When the symptom clears it ordinarily does so rapidly and without any tendency to recurrence.

Attempts to fix the true etiology of hemorrhagic diathesis in the new-born have been inconclusive. Ulceration in the gastro-intestinal tract has been described in some cases, and its occurrence has been variously estimated at from 5 to 40 per cent. Thrombosis and infarction during the stage between the fetal and adult types of circulation have been mentioned as causative factors, particularly in association with the general congestive reaction described. Vascular atony and subsequent effusions have been attributed to trauma at the vasomotor centers, but the two phenomena are inconstant in their association. Sepsis has not been established as a constant etiological factor; the occasional demonstration of bacteria in the blood at autopsy may well be an effect rather than a cause, attributed by some to the accessibility of the circulating blood to the intestinal lumen through tissue which has been damaged by the original disease. Since so many of the explanations offered are insufficient, it is likely that the problem will ultimately be solved by the recognition of definite alterations in the blood, *per se*, with

the accompanying lesions occurring as secondary or contributing factors.

Two types of hemorrhagic disease are thus recognized: In one, a delayed coagulation-time presumes a deficiency in prothrombin; in the other, coagulation-time is normal, but a lesion of the vessel wherein thrombo-kinase production is lacking, is held to be causative. The former is the more common condition, but the mechanism of its production, be it mechanical, infectious, toxic or a combination of these, is as yet undetermined.

The variable significance of vaginal bleeding in the first week has been mentioned. Nasal hemorrhage, in addition to the rare instances of communicating cranial injuries, luetic rhinitis, diphtheritic membrane formation and general sepsis, may be one of the manifestations of hemorrhagic disease recognizable either by external bleeding or by melena spuria.

Ecchymoses involving the palate, the gums and the tongue accompany the disease occasionally, but it should be remembered that small, punctate hemorrhagic points are often seen upon the hard palate in normal infants during the early suckling period. Likewise, alterations in the palpebral conjunctivæ may appear, whereas bleeding into the bulbar membrane is more often of the congestive type. Cutaneous hemorrhages of variable size, but usually of a confluent type, are often seen on the broader skin areas, particularly upon the trunk, or upon points especially subject to pressure, such as the buttocks, the heels or the occiput. Upon their absorption, following treatment, there may be icterus and large quantities of bile in the urine.

Treatment.—Blood transfusion is the specific remedy, and upon the first suspicion of true hemorrhagic disease approximately 50 cc. should be given in the longitudinal sinus. Citrated blood is most commonly used, more as a matter of expediency than of choice. It is highly desirable to employ matched bloods, particularly from one of the parents, but the use of the mother's blood is permissible as an emergency

measure. However, when transfusion cannot be properly executed it is safer to employ intramuscular injection of whole uncitrated maternal blood. Injections of 10 to 15 cc. are best made in the gluteus or hamstring group and, like transfusion, may be safely repeated as often as is necessary to check the disease. As an alternative to these devices, horse serum is a satisfactory substitute in providing the essential elements for blood coagulation.

In the matter of therapy a forward step has been taken in the recognition of the stimulating effect upon the platelets of exposure to ultra-violet light. This has proven to be a valuable adjunct to treatment.

Although nursing is best suspended for the conservation of the infant's strength, persistent attempts to maintain nutrition are urgently indicated. Small amounts of cooled milk may be administered frequently. A tendency toward a subnormal temperature must be met by the application of external heat, and the fluid intake should be generous. Superficial bleeding from the umbilicus, for example, often can be controlled, at least as an emergency measure, by pressure packs, preferably saturated with adrenalin, but at times the ooze is very difficult to combat, and in such cases the prognosis is relatively serious.

Anemia and Leukemia.—Essential *anemias* in the new-born are extremely uncommon, but the secondary reactions after hemorrhagic disease, sepsis and syphilis may be very severe. *Leukemia* is described as a congenital disease, but it appears to be unrelated to any preëxisting lesion in the parents. Marked abnormalities of the blood are usually associated with splenic enlargement, as is true of general sepsis and syphilis.

In differential diagnosis the following must be considered:

(*a*) *Syphilis.*—Later appearance; more constant splenic and liver enlargement; Wassermann; stigmata of congenital lues.

(*b*) *Sepsis.*—History; symptoms and signs of infection.

(*c*) *Cerebral Hemorrhage.*—Normal bleeding- and clotting-time (three and a half and seven minutes respectively); rapid, early progress as a rule; no other hemorrhage; history of delivery.

(*d*) *Melena Spuria.*—From bleeding nipple, etc.

(*e*) *Enteric.*—Prodromal signs of intestinal inflammation, without bleeding; small amounts in the stools, in contrast to copious hemorrhage of true melena.

GENITO-URINARY SYSTEM.

The presence of albumin and casts in the urine of the newborn has been noted, but persistent signs of kidney damage are very unusual. In spite of occasional reports to the contrary, the bulk of the evidence at hand indicates that maternal nephroses are not ordinarily reflected to the kidneys of the infant, either by the transmission of toxins supposedly causative of the disease, or by the products of metabolism which are inadequately excreted. Prematurity and underdevelopment in the infants of mothers suffering from chronic nephritis are doubtless explainable upon a much broader basis, the details of which are not thoroughly understood, although the almost constant presence of large infarcts in the placenta would afford an explanation for a great decrease in fetal nutrition.

Congenital hematuria, which tends to be self-limited, is occasionally seen, but prolongation of the bleeding suggests some organic lesion (hemorrhagic disease, renal thrombosis and infarction, or even calculus).

Intermittent hydronephrosis follows obstruction, most frequently ureteral, and the tumor produced resembles the congenital cystic kidney. The latter, however, is a primary renal defect of development, probably caused by the failure of union between the glomerular and the "ureteral" portions of the tubules, with subsequent cystic dilatation of the former. It usually occurs bilaterally, and the prognosis

depends largely upon the amount of normal renal parenchyma that is present.

Malignant tumors of the urinary system have been described and innumerable congenital malformations, of which the most frequent are (1) a patent urachus, and (2) ectopion of the bladder. Treatment is surgical, but in the latter lesion, the results are consistently discouraging.

Simple infections of the normal bladder and kidney pelvis are notably infrequent in early infancy.

Male Genitals.—The testes are very mobile in the new-born and vary in position between the scrotum and the internal abdominal ring, but if they cannot be palpated in the inguinal canal, we have to deal with cryptorchidism, which is usually not amenable to treatment, and is associated with such atrophy of the specific cells that the individual is usually sterile in later life. Congenital hydrocele and hematocele are usually small and require no specific treatment. *Epispadias* and *hypospadias* are problems for the urological surgeon, but it is generally thought that operative interference is best deferred to a later date. Complete atresia of the urethra is very rare and requires immediate surgical relief, but more often a membranous closure of the meatus is observed, which can be cured by release of the adhesion.

Phimosis.—A certain degree of adhesion of the foreskin is almost uniformly present. Daily attempts at retraction will overcome most cases, although certain ones will require repeated efforts to effect complete relief. Where this seems to involve too great difficulty the indication for circumcision is clear, although the operation is much more frequently done on account of parental preference, religious ritual and the like.

Circumcision may be done by many methods, probably with generally satisfactory results. After repeated trials with several techniques we present a method which has been consistently satisfactory in our hands.

A single straight clamp is loosely applied to the redundant

skin parallel to the long axis of the body, and is secured at a point slightly lower on the ventral surface than upon the dorsal to escape the frenulum posteriorly. The foreskin is placed under slight tension, and is excised with a knife *below* the clamp, in order to preserve untraumatized tissue for the sutures. The outer skin is at once excised to the desired point, but the mucous membrane often remains adherent to the glans, after which it is incised up the dorsal aspect with fine scissors as far as the corona, and thence trimmed down on each side. A suture is placed on either side of the frenulum, and the rest of the circumference approximated by about three stitches, either of fine black silk or of "zero" plain catgut. A non-occlusive dressing of vaseline gauze is applied after the fashion of a cigarette wrapper, and secured by one or two circular ties of the same suture material. This dressing will frequently remain until healing is complete.

The dorsal slit operation is never recommended as an alternative to circumcision, but it is occasionally useful for the cure of a paraphimosis, resulting from failure to replace the foreskin subsequent to its retraction, or for the relief of unexplained diffuse cellulitis of the soft tissues.

Female Genitals.—Generalized swelling of the genital tissues in the new-born is probably another manifestation of the metabolic adjustment between the uterine and extra-uterine life. The return to the normal state is usually prompt and uncomplicated. The vagina remains sterile for only a few (three to four) hours, after which mixed cultures are obtainable, but after about the twelfth hour the normal vaginal flora predominates, consisting chiefly of Döderlein's vaginal bacillus.

Gonorrheal infection of the vagina is more rarely encountered in the new-born than ophthalmia, which is quite logically explained by the fact that in the course of a normal labor the parts are exposed to the possibility of a maternal infection for a much briefer period. The disease usually

becomes apparent about the second week, and the vulvar mucosa shows bleeding points, in addition to the other characteristic signs of inflammation. Upward extension is infrequent, but both the urethra and the vagina may become involved.

Treatment is prophylactic, with weak silver applications to the vulvar mucosa in suspicious cases, but as soon as the smear shows the presence of gonococci, a more intensive treatment with similar compounds is required, and extraordinary efforts to maintain cleanliness are imperative. The disease, unfortunately, tends to the same chronicity as in later childhood.

Malformations in the female are less common and less significant than in the male. Filmy adhesions between the labia are usually separated with ease, and unless this is carried out the retention of irritating secretions may ensue. An imperforate hymen can be safely left untreated until later in life.

External hermaphroditism is the only important type of malformation in the new-born, as it is frequently associated with other congenital abnormalities. The finer distinctions often necessary to a diagnosis of sex are problems requiring highly specialized knowledge and considerable experience in embryology. It is sufficient to state here that the presence or absence of the testicle is the basis of such decisions, although the individual may reach the age of puberty and require operative investigation before final conclusions are attainable.

DIGESTIVE TRACT.

In infancy the mucosa of the mouth shares in the primary congestive reaction as well as in the subsequent dehydration tendency. Several pictures are described, from punctate ecchymoses to grayish nodules upon the palate, all of which are ordinarily self-limited in the absence of trauma, the latter

being most frequently sustained in the course of superfluous hygienic measures directed to the mouth cavity. In the latter case the simple ulcerations which follow may heal readily, but are as likely to terminate in severe stomatitis with hemorrhage, necrosis and sepsis. The mouth in infancy appears quite resistant to its normal bacterial flora, as long as the mucosa remains intact. It is strange that gonorrheal stomatitis is not more frequent, since the Neisserian organism so frequently affects surface tissues, but the cases described are rare and not conclusive.

Thrush is one of the commonest mouth lesions of infancy, and it is important to recognize it early because of its highly contagious character. *Oïdium albicans* is a fungus, in contrast to a bacterial organism, and appears in white patches over the tongue and buccal surfaces. As a rule, the apparent pain that it creates directs attention to it. It is important to differentiate it from milk curds, which are freely movable by a cotton-covered toothpick swab, while the thrush patch is more adherent and leaves a raw surface after its removal. Microscopic examination of a "smear" establishes the diagnosis. The source of the infection has been variously attributed to the nipple, to the vagina and to careless hygienic oversight. Many authors believe that it occurs only in infants whose resistance to infection is lowered.

Three cardinal principles of therapy apply particularly to this disease: (*a*) Prophylaxis, with avoidance of any trauma to the child's mouth, either in its immediate postpartum care or during its routine nursery management; (*b*) isolation; (*c*) changing the normal reaction of the host's tissues from a slightly acid condition, which fosters the fungus growth, to the alkaline state, in which further development is inhibited. This is accomplished by hourly applications to all parts of the oral cavity of saturated solutions of sodium bicarbonate upon a soft cotton swab. Gentian violet (1 per cent) has likewise proven beneficial. Nursing is best suspended during the acute stages of the disease.

Tonsillar infections, as seen in childhood, are practically unknown in the infant. The tongue, in addition to the *macroglossia* of mongolism and idiocy, is only subject upon rare occasions to hemangioma and cyst formation.

Persistence of the lingual frenulum is a common abnormality and, although it should give rise to no difficulty in nursing, its correction is so simple that it is best done within the first few days of life. With a sharp-pointed scissors the free edge of the frenulum is cut, and with gentle backward pressure by the gauze-covered finger the veil of tissue is obliterated to its base. The child's mouth can be easily held open by a finger inserted at the angle of the mandible. Bleeding is less troublesome by this technique than with sharp dissection throughout.

In the occasional case of *precocious dentition,* oftenest involving the lower central incisors, nursing is rendered difficult or impossible. Whereas extraction is recommended by some authorities, the possible effect upon subsequent development of the jaw must be considered.

Cleft palate and hare-lip may be associated, or they may occur independently. Operation is always indicated, the lip defects being amenable to correction at any time after birth. The operation for cleft palate is usually deferred a year or more. One of the chief deciding factors is the ability of the child to take nutrition.

For the occasional case of tumor, calculus and malformation of the salivary glands, reference is made to larger works upon pediatrics.

While most disorders of the digestive tract in infancy are referable solely to disturbed function, true organic defects may exist and constitute a more serious problem. The commonest of these are:

(*a*) **Obstruction.**—This may result from malformation at any point. Esophageal atresia is rare, and is usually associated with a tracheal communication, so that a complete inanition becomes complicated with pulmonary infection

from aspiration. The only life-saving measure consists in gastrotomy, but the operative mortality is high, and the general prognosis is very bad.

An example of endogenous obstruction is that referable to pyloric stenosis, previously mentioned. The lesion here is a simple localized muscular hyperplasia, and is likely to be associated with projectile vomiting which usually occurs late, at the second or third week; constipation; gastric distention, with visible peristalic waves; and at times a palpable mass. The etiology is not clear, as in the case of many congenital malformations. Treatment is surgical, by simple division of all the layers of the pyloric wall down to the mucosa.

Atresia of the duodenum is the commonest lesion of the small bowel, and consists essentially in an hypertrophy of the mucosa, which quickly leads to complete occlusion, with characteristic symptoms. Vomiting is early, and the color of the bowel contents varies with the position of the lesion, in relation to the opening of the common bile duct. Bowel action, the character of the discharges and the associated constitutional symptoms vary with the severity of the lesion. The practice of anastomosing the functional portions of the tract is the only rational treatment, but the general condition of the infant upon the establishment of the diagnosis renders the surgical risk very dubious.

Congenital bands, compressing the lumen of the gut from without, are more amenable to surgical relief. Stenosis and atresia of the terminal ileum and cecum occur less commonly and the colon is very rarely involved, but the latter may be suspected if persistent vomiting is delayed and bowel action is suppressed early.

Imperforate anus is not uncommon, and calls for early surgical interference. It may take the form of a simple *atresia ani*, or *atresia recti* may exist, where the rectum is converted to a solid structure. Abnormal rectal openings may appear alone, for example, in the vagina; or in combination with a normal anus (fistula).

The very occasional example of pressure from neighboring tumors might be included among the rarer lesions. Any lesion of this type provokes much the same syndrome, *i. e.*, vomiting, asthenia and dehydration, and the longer the symptoms continue the greater the surgical risk. Generally speaking, the higher up the obstruction occurs, the worse is the prognosis.

(*b*) **Hernia.**— *Diaphragmatic hernia,* wherein the abdominal viscera, and particularly the intestines, escape into the thoracic cavity, is generally first suspected by the respiratory difficulty created. The rate is rapid and the breathing is shallow, although irregularities are less constant, and cyanosis regularly ensues. The condition is generally unilateral, the left side predominating in frequency of occurrence; and in outspoken cases there is visible increase in the size of the affected thorax, with a correspondingly sunken abdomen. The heart may be markedly displaced, and its normally dull percussion note replaced by the tympany of the underlying gut.

The diagnosis may be further suggested by the progressive elimination of the other common causes of cyanosis in the new-born, while it may be made conclusive by the bismuth roentgen-ray. The prognosis is uniformly bad.

Hirschsprung's disease (megacolon), although not uniformly secondary to a demonstrable obstruction, is thought to be dependent in most instances upon a kinking or twisting of the bowel in the region of the sigmoid; or else to spastic contracture in the same area. Idiopathic hypertrophy of the colon underlies the original description of the disease. Cardinal symptoms are distention, constipation and visible peristalsis, appearing in the order mentioned, with vomiting and dehydration later. Secondary thoracic symptoms often complicate the picture. The onset of the symptoms may be early (65 per cent), or delayed, while abortive forms may show an early spontaneous recovery. Treatment consists in the correction of any demonstrable obstruction, daily ene-

mata and the administration of antispasmodics (atropine, etc.), if there is evidence of spasm. An in-dwelling rectal tube has been employed with variable success.

Peritonitis.—Inflammations of the peritoneum *in utero* have been ascribed to maternal tuberculosis, syphilis and sepsis, while a similar lesion is said to be associated, at times, with fetal volvulus and atresia. In the new-born acute peritonitis has its origin most frequently from the umbilicus, while it may follow intestinal pathology, viz: diverticulitis, or perforation following obstruction. Erysipelas may terminate in an infection of the peritoneum, and, lastly, the lesion may be seen with no demonstrable organic basis.

The symptomatology is very inconstant. There may or may not be a high fever, but the pulse and respirations are inclined to rise; diarrhea is common, but constipation may occur; vomiting is frequent, and there is usually distention, tenderness and, in the late stages, icterus. There is no promising treatment further than supportive and symptomatic measures.

Diverticulum.—A persistent omphalo-mesenteric duct, the embryonic connection between the gut and the yolk sac, may end blindly and go unrecognized, or may present at the umbilicus. Such a fistula discharges an alkaline secretion in contrast to the acid reaction from a patent urachus. Operation is the treatment of choice, but if the condition is uncomplicated, it is best deferred until the infant has attained steady growth and development.

The **liver** is rarely the primary focus of pathology in the new-born, but its relation to many disease processes has been emphasized. It first receives any toxic or infectious element from the intestine or from the placenta, and it is quickly affected by any injurious element from the hematogenous side, whether bacterial or toxic. The frequency of icterus, of which many definite types are recognized (obstructive, septic, toxic, catarrhal) shows the susceptibility of the organ to trauma, as well as its intimate

relationship to the general metabolism. Hepatitis, parenchymatous and fatty degenerations, hemorrhagic lesions and atrophy are described. Cirrhosis is seen as an accompaniment of syphilis. However, the development of independent studies of liver function is so recent that their practical application to the problems of infant pathology is not established.

Congenital gall stones are described, as well as *stenoses* and *atresias of the bile ducts,* which sufficiently often involve the common duct to cause early icterus and clay-colored stools. Death usually ensues early from digestive disturbances.

A very few cases of pathological changes in the liver and biliary system have been described, from cystic structures to primary carcinomata; but of these, the most frequent is the hepatic extension of hypernephroma.

Umbilicus.—(*a*) *Granuloma.*—Upon healing of the umbilicus there is frequently an over-production of granulation tissue, which remains moist and red, giving the appearance of an infection. Cauterization with a silver nitrate stick or scissors dissection followed by the caustic is curative.

"Amnion navel" represents the encroachment of the amnion upon the skin surrounding the umbilicus. "Cutis navel," which is more common, is an outward growth of skin upon the base of the cord. Both conditions are ordinarily self-corrective.

A fecal discharge from the umbilical ring is practically an indication of persistent diverticulum.

(*b*) *Hernia.*—Umbilical hernia in the new-born is frequent, but it rarely causes trouble except when the size is excessive. Little can be accomplished by way of prophylaxis, with the possible exception of avoiding undue traction upon the cord and unnecessarily bulky dressings over the stump. As a rule, the degree of herniation is clearly demonstrable only after complete scarring of the navel. At least, the most satisfactory test of its extent, palpation of the defect, is perfectly safe at this time, but not prior to complete healing.

Umbilical hernia is so easily remedied in the majority of instances that every case deserves treatment. The old-fashioned practice of fixing a flat object like a coin over the rupture is neither rational nor effective. Likewise, the use of abdominal binders has no prophylactic value against herniation. A non-surgical method of effecting closure is to draw the recti muscles together over the hernia by external manipulations, and while held securely in this manner, a wide (4- to 5-inch) adhesive strap is tightly applied across the abdomen, reaching well past the axillary line, posteriorly. This is kept in place continuously for five to six weeks, and upon its removal the muscles and their fasciæ will maintain a permanent closure of the defect in almost every instance. The surgical approach after failure of conservative treatment should be determined by the size and the possible symptom-bearing aspect. Large defects involving ectopic viscera call for early operative interference, preferably within the first few hours of life.

Hernia at the inguinal and femoral ring is occasionally observed in the new-born, but operation should be postponed in most instances. Females are said to be more frequently affected, quite in contrast to the ratio obtaining in the adult.

(*c*) *Infection.*—Although the normal process of cord separation is evidenced by a red line at the base, where the amnion and the skin unite, this granulation tissue should not be confused with the more diffuse reddening accompanied by swelling, local heat and sensitiveness (omphalitis). The latter calls for warm, wet, antiseptic compresses, plus constitutional treatment and watchfulness for evidences of spreading until the lesion has run the course of any infection, *i. e.*, toward resorption, local suppuration or generalized extension. The commonest pathogenic organisms concerned belong to the tetanus and erysipelas group.

Gangrenous change in the stump rarely ensues with or without the development of a spreading infection. Removal of the affected tissue by dissection or by thermocautery and

treatment of the remaining stump by antiseptics is indicated. Local abscess formation rarely results, but extension to the peritoneum is common and carries a mortality-rate of about 85 per cent.

At times arteritis or periarteritis of the umbilical vessels is responsible for an otherwise unlocalized sepsis; and umbilical phlebitis, while less common, is more serious through its intimate relation to the liver and heart. This lesion often underlies the picture of sepsis in combination with icterus.

CHAPTER XII.

DISORDERS OF SPECIAL SYSTEMS.—*Continued.*

CONGENITAL ORGANIC DISEASE OF THE NERVOUS SYSTEM.

The malformations most frequently seen are: (*a*) *Acephalia,* or a total absence of the cranial structures, and (*b*) *anencephalia,* or absence of the cerebral hemispheres. The medulla and basal ganglia are usually preserved, while the cerebellum is variable in its development. Early fatality is the rule, but while life lasts the basic reflexes are present and the muscular tonicity is generally increased. (*c*) *Encephalocele* is a herniation of the brain and meninges through an abnormal defect in their covering, and is caused by the faulty closure of the cephalic extremity of the medullary tube. It is most often seen in the mid-line of the occipital region, beneath the external occipital protuberance. The frontal type points at the root of the nose, and the basal type in the pharynx, but these are quite uncommon. A *meningocele* is a herniation consisting only of meninges. The size is inconstant, and the covering varies from normal skin to a bluish membranous roof. Hydrocephalus usually follows operative interference, undertaken for the relief of this condition.

(*d*) *Spina bifida* is more common than encephalocele, but the mechanism of production is the same, in that there has been a failure of closure near the caudal end of the medullary canal, usually in the lumbo-sacral region. With a *myelocele* there is usually paralysis below the lesion, including the loss of sphincter control. The prognosis is

best if there is a complete covering of skin, but measures designed to promote skin growth over a defective area have proven disappointing. The most common sequel is hydrocephalus, while the tendency to infection is very marked. Surgical methods of closing the defect are rarely effectual, and even in the occasional instance of a satisfactory technical cure the hydrocephalus practically always tends to become progressive.

(*e*) *Hydrocephalus,* which is almost always of the internal type, is a relatively rare complication in the new-born because of the frequent necessity for a destructive operation in order to effect delivery. It has been attributed to an intra-uterine serous meningitis, but in most cases it is directly due to a closure of the foramen of Magendie, the etiology of which is entirely unknown. At other times it follows intracranial hemorrhage with subsequent interference in the path of the cerebrospinal fluid. The symmetrical cranial enlargement, or the occasional bizarre alterations in shape, along with muscular spasm and increased tonus, hyperactive reflexes and convulsions, constitute the clinical picture. The condition tends to become progressive and is not amenable to surgical relief.

The toxic and infectious group of lesions comprises: (*a*) *Meningitis,* which occasionally results from a middle-ear infection or represents a terminal stage of sepsis; it is of rare occurrence, is rarely diagnosed in life, runs a variable symptomatic course and is always fatal. (*b*) *Encephalitis,* which in infancy is known only in the suppurative form, is usually a metastatic lesion or an extension from a septic meningitis.

Rare instances of independent neuro-muscular atrophies and paralyses are described, presumably having their origin *in utero,* but are without an assignable pathological basis. Likewise, the central nervous system is liable to septic and toxic influences from distant foci. Acute poliomyelitis in the new-born has not been conclusively demonstrated.

CONVULSIONS.

The convulsion, like fever, is simply a sign of non-specific character, which points to organic pathology or disturbed function. Either through direct injury or through toxic influences, the central nervous system is rendered unstable and hyperirritable. A tendency to simple overactivity of all the flexor muscles at birth is often noted, but this reaction is without importance. True convulsions in the new-born may or may not have a serious significance, differing in this respect from the adult reaction, wherein convulsions practically always point to deep-seated pathology.

The most serious underlying cause of convulsions is direct brain injury. If such is present the history of the course of labor suggests the diagnosis, but it should always be recalled that cortical trauma may follow a *precipitate* spontaneous delivery, as well as operative interference, while contracted pelvis, ill-advised injection of pituitrin and other common etiological factors may be concerned. Cerebral injury manifests itself within three to four days after delivery, whereas convulsions due to other causes occur much later.

This type of convulsion is associated with a fairly constant clinical picture of stupor between the seizures, neck rigidity, anomalies of the fontanelles or sutures in some instances, a unilateral symptomatology in many cases, absence of fever and frequently a progressive involvement, varying with the extension of the hematoma. Lumbar puncture is of great value in establishing the diagnosis.

A convulsion frequently signifies the onset of infection, not solely of the severer grades, but of milder character as well. Meningitis is the most serious of the infections commonly attended with convulsions. It may simulate the commoner lesion of traumatic hemorrhage, but is also accompanied by fever, leukocytosis and the characteristic spinal fluid changes. Since the causative organism is rarely the meningococcus,

the treatment is non-specific, and consequently must be purely symptomatic. One possible explanation for an early meningitis is sought in the aspiration of infected amniotic fluid, which gains entrance to the middle ear.

Occasionally, convulsive states are attributable to: (1) *Tetanus neonatorum*, which, fortunately, is rapidly decreasing in frequency. They tend to appear from the end of the first week onward, with characteristic early involvement of the facial muscles, while those of the trunk and extremities appear at a later date. The tonic seizures are attended with high fever, but are without constant findings in the spinal fluid. (2) The rarely observed *eclampsia neonatorum*, following toxemic states in the mother, although some cases are doubtless referable to the trauma sustained in the course of delivery. (3) *Tetany*, or rather, tetanoid seizures, resembling in many respects the true spasmophilia of later infancy and childhood.

Occasionally a convulsion may follow a sudden change in environment or of food, and in the later stages of the infant's development, convulsions appear to have their basis in a gastro-intestinal disorder. Epilepsy may have its ultimate origin in a birth trauma, but the reaction is not seen in early infancy. Syphilis in the new-born may likewise produce this symptom, presumably through a toxic influence, but occasionally as a result of the associated prematurity, which predisposes to cranial injury at birth. As the terminal event of a serious organic lesion or septic state, convulsions are very common.

Regarding treatment, the determination of the cause is the fundamental step. For the actual attack the usual recommendations are: (1) A minimum of cutaneous stimulation, such as avoidance of excessive handling; (2) immersion in a hot tub (105° to 110° F.) for its sedative effect, with cold compresses to the head; (3) gastric lavage where indicated, along with an enema or proctoclysis of weak sodium bicarbonate; (4) stimulation of respiration with a whiff of aromatic

ammonia, or artificial respiration where needed; and (5) the inhalation of chloroform (with abundant air) in persistent cases.

THE EYE.

True congenital abnormalities of the eye are described and they include affections of the lids (entropion, adhesions, tumors and lacrymal duct occlusions); occasionally angioma or dermoid of the conjunctiva; more often, opacities of the cornea, which may be luetic or non-specific, as well as yellowish-white elevations (lipo-dermoids); and, finally, of the inner structures, such as coloboma, defects in the anterior capsule of the lens, congenital cataract, changes in the disc and fundus. Attention is particularly directed toward the occurrence of congenital and permanent blindness due to degenerative and atrophic conditions of the optic nerves, although such lesions are rarely recognized until the child becomes older. Microphthalmos, or a completely defective development of the eye, is also recognized. Displacements of the globe may follow orbital tumors, hemorrhages or direct traumata. Paralyses of the extra-ocular neuro-muscular elements have been mentioned.

Among the acquired ocular lesions, it is stated that from 20 to 25 per cent of all new-born infants show fundal hemorrhage of variable degree, at times involving the border of the disc. These result from vascular congestion during labor, the same mechanism that is said to produce ecchymoses in the bulbar conjunctivæ. These petchiæ are self-limited and require no specific treatment.

Ophthalmia Neonatorum.—The liability of the eyes to infection in vertex presentations has been pointed out, and any factor tending to protract the labor in a patient infected with gonorrhea increases this likelihood. When the membranes have ruptured early in labor, the organisms may even reach the uterus, where the constant warmth promotes their development.

Infection developing *after* the fourth day has ordinarily been acquired in extra-uterine life. The infection begins in the conjunctivæ, and usually remains limited to these surfaces, both bulbar and palpebral; but if unchecked, it may invade the cornea and eventually the anterior chamber. It should be constantly borne in mind that more cases of acquired blindness are due to gonorrheal ophthalmia than all other causes combined, so that mankind will remain under perpetual obligation to Credé, who demonstrated the value of silver nitrate, not only as a prophylactic, but also as a remedial measure.

The practice of instilling silver nitrate into the infant's eyes calls for a word of caution, for when it is applied carelessly the specific effect desired is frequently complicated by a reaction. A purulent discharge appearing from twelve to twenty-four-hours after birth ordinarily means a non-specific "silver" reaction; but since a fulminating Neisserian infection may occasionally appear at this early period, every case calls for diagnosis and treatment. Occasionally the treatment may be ineffectual from the use of inert solutions, or from failure to introduce it into the conjunctival sac.

It might be added here that gonorrheal infection may appear where it is least suspected. A thin smear of the exudate stained with methylene blue will show the causative diplococci if the more specific Gram stain is not available.

Ophthalmia may be associated with little else than a watery or purulent exudate, but in more severe cases there is extreme redness and swelling of the lids, a granular appearance of the palpebral conjunctiva, with occasional punctate ecchymoses and, later, clouding of the cornea with subsequent ulceration or sloughing. The edema of the surrounding tissues may be extreme, and the eyes are often so swollen that they remain constantly closed and the lids can be opened artificially only with great difficulty. The infection is usually bilateral in silver reactions, but may occur on one side or both in gonorrheal infection.

Treatment.—In the non-specific form the disease is self-limited under ordinary hygienic measures, and regular irrigations of boric acid, followed 2 to 3 drops of $ZnSO_4$ ($\frac{1}{4}$ gr. to the ounce of water), soon lead to a prompt cure. On the other hand, when the gonococcus is found in the diagnostic smear the most intensive treatment is necessary:

Isolation and a special nurse are the *sine qua non* of proper care. If only one eye is involved the other should be covered by a shield secured as tightly as possible at its edges, to prevent a spread of the infection. Extension of the lesion to the cornea, with ulceration and occasionally panophthalmitis are the chief complications to be feared. The climax of the infection is reached in about three days on an average, but the complete recovery is much slower. Pus as it forms is wiped away, and cold compresses consisting of cotton pledgets wrung out in ice-water are applied intermittently to the outside of the lids. Prior to the direct application of treatment to the involved tissues, the conjunctival sac is irrigated with warm boric acid, in order to render the seat of the lesion more accessible to medication. Following the irrigations, which should be repeated every two hours, argyrol (15 per cent) should be instilled. Mercurochrome (1 to 2 per cent) has been employed with variable success, but it does not compare with the silver compounds in efficiency. Occasionally both are used—alternately. The *lids* are painted with 1 per cent $AgNO_3$ once or twice a day. Over-treatment with the stronger chemicals tends to maintain the inflamed condition and should be avoided. The iris may be protected by dilatation with atropine (1 to 2 drops 0.5 per cent q.d.), while the course of the disease is repeatedly checked by smears, as a supplement to clinical observation.

Rarer types of ophthalmia, varying in intensity and seriousness between the purely non-specific and the Neisserian, have been described. In such cases cultures have yielded the pneumococcus, staphylococcus, streptococcus and the Koch-Weeks bacillus. In them the general principles of treatment are identical with those first described.

THE EAR.

Purulent otitis media occasionally occurs in infancy. It is often first recognized by perforation of the tympanum, while it may rarely provoke a sinus thrombosis or meningitis. The infection doubtless arises most frequently from contaminated amniotic fluid, while some authors attribute early infection to the ingress of bacteria to the tympanic cavity during the act of vomiting.

THE SKIN.

The importance of frequent and thorough cleansing of the skin has been emphasized in the résumé of nursing care of the new-born. After the removal of the protective coat of vernix the tissues are sensitive and hypersusceptible to trauma, since the sweat glands are relatively inactive, while the sebaceous glands yield an irritating secretion.

While the new-born possesses no specific immunity to any of the familiar skin lesions, there are certain types which predominate.

Icterus Neonatorum.—The yellowish discoloration of the skin in the new-born is considered physiological by most authorities. It is variously estimated that 30 to 80 per cent of all infants are affected in some degree, with a relatively increased frequency among the premature and among infants showing excessive weight losses. Jaundice is generally most intense from the second to the fifth day, and has an average duration of five to seven days. Its fading is usually accompanied by generalized scaling of the skin, but occasionally the desquamation occurs in somewhat larger plaques. Icterus is normally unaccompanied by fever or other constitutional signs; and while some evidence attributes it to blood destruction, other observers refer the condition to a temporary disorder in the biliary system. Icterus neonatorum is ordinarily self-limited, and requires no treatment, but is at times

a sign of serious pathology, and it may be sufficiently severe to threaten the life of the child.

Icterus Gravis.—Occasionally there is seen, in contrast to physiological icterus, a more intense type, due to accessory etiological factors. It begins early, quickly increases in intensity, and is associated with the excretion of bile pigment in the urine. Stools are neither acholic nor do they show melena, but blood-streaked mucus is sometimes seen. The vital signs are not characteristically affected, but death usually ensues within a week, with a terminal syndrome resembling that of meningitis. At autopsy the tissues of the brain and cord are deeply tinged with yellow pigment, and among the viscera, the spleen constantly shows enlargement. Hemorrhagic effusions into the serous cavities and the viscera are often commonly seen. More often however, icterus may result from general sepsis, with blood destruction, at times to the exclusion of other and more characteristic signs. A colon bacillus septicemia has been demonstrated as one causative factor, and recovery has ensued after repeated transfusions. Associated with this disease there has been noted a marked reduction in blood platelets, which tend to be increased by repeated brief exposures to ultra-violet light.

A congenital luetic hepatitis is described, and malformation in the biliary system may cause obstruction in rare instances. Other lesions that may be complicated by icterus are: (*a*) *Buhl's disease.* Acute fatty degeneration in the new-born is a very rare occurrence. It has been termed a "hemorrhagic sepsis" and usually follows severe asphyxia, which merges into a clinical picture that is hardly distinguishable from a severe hemorrhagic diathesis, but which is associated with fatty degeneration of the viscera, along with bleeding into the involved tissues. (*b*) *Winckel's disease* is another remarkable and uncommon disorder, characterized by an unexplained, generalized cyanosis, appearing about the fourth day, and followed by jaundice and hematuria, without fever. Early death is the rule, and the findings at autopsy are essen-

tially hemorrhagic renal infarction, gastric dilatation with petechiæ in the mucosa, hemorrhagic enteritis, enlarged mesenteric glands and splenic hypertrophy. Bacteriological findings are inconstant, and the ultimate etiology of the syndrome is quite unknown.

Congenital Disorders.—Small skin defects most commonly affect the vertex, and are presumably attributable to amniotic adhesions, since their fresh appearance at birth suggests a recent origin. In subsequent epithelial growth over these superficial defects the accessory structures (hair follicles, etc.) are lacking.

Very small white papules often occur about the face of the new-born (milia), and are attributable to excessive sebaceous secretion with insufficient drainage. The same condition obtains in the sweat glands at times, producing a vesicular lesion (miliaria). Both conditions are self-limited under normal hygienic care. Secondary infection is very rare.

Telangiectases are temporary cutaneous vascular dilatations and are often seen at birth. They are normally a pinkish-red, are compressible to whiteness and are usually sharply defined. These tend to correct themselves within the first days of life.

Nævi are of a bright blue-red color, irregular in outline as a rule, and tend to increase in size rather than to clear. The surface may be roughened and elevated. Treatment by plastic surgery, or with carbon dioxide snow, is recommended in early infancy whenever the lesion is disfiguring.

Peeling tendencies in the skin are seen in many forms, from the rapid and fatal *congenital ichthyosis* to the physiological desquamation of the new-born. An intermediate form (*ichthyosis sebacea*) is associated with a drying and cracking tendency, followed by coalescence of the lesions. Fairly deep fissures may be produced thereby. Following the initial peeling, where the skin may detach in plaques, rather than scales, the normal condition is rapidly established.

Erythema.—A fairly intense erythema is physiological in the new-born, and doubtless represents an attempt at temperature adjustment; it is most evident in premature infants. After about the second day there is a gradual diminution of intensity, and scaling sets in, possibly due in part to a toxic alteration so produced. A dull, reddish maculo-papular rash, either punctate, coalescent, or both, may arise as a complication, particularly after over-heating of the skin, ill-advised bathing, or mechanical irritation. These will disappear spontaneously in time, but clearing is hastened by the substitution of oily baths instead of soap, and liberal applications of powder to affected parts. If the rash is generalized it may begin to clear in localized areas. Authors who believe this lesion to be secondary to enteric disturbance designate it *erythema toxicum*. It is better known to the laity as "prickly heat."

Intertrigo.—Intertrigo, which is the commonest "eczematous" lesion of infancy, is limited ordinarily to the diaper area, and prophylaxis is secured by thorough vigilance against irritation. Once acquired, it is managed by: (*a*) Restraint of the hands to prevent rubbing the affected area; (*b*) oil baths, with daily removal of the crusts; (*c*) application of Lassar's paste, or white precipitate ointment in one-third strength to the affected areas. Weak antiseptics, such as 1 per cent mercurochrome, may be used profitably.

When ordinary redness is complicated by papular or vesicular rashes dry heat is efficacious. At times the diet is a contributing factor, and the lesion is seen particularly when protein milk or an excess of fat is taken.

Infectious lesions, particularly sepsis, may provoke thrombosis and gangrene, cases having been reported which involved the extremities, the scrotum and the umbilicus.

Impetigo Contagiosa.—Impetigo contagiosa is usually a staphylococcus infection, vesicular in type, and localized between the epidermis and the corium. The contents of the vesicles may be serous or purulent, and the individual blisters

often become coalescent. They tend to be round, and are usually encircled with a red areola. The smaller lesions are tense, and the larger ones flaccid or "baggy," and, although they characteristically appear in crops, they are visible in all stages of development from the earliest reddening to that of new epithelial growth. The blisters appear chiefly upon the exposed surfaces, and their rare localization upon the palms and soles aids in differentiating it from syphilis. Constitutional symptoms rarely accompany the disease, and many cases are abortive and self-limited. Although a few authentic cases have been reported at birth, the vesicles usually appear about the second week. It is highly infectious, contagious and epidemic in character, coming on at any period of early infancy, and is often progressive in the absence of early treatment. Fortunately, however, it is rarely fatal.

Immediately upon its recognition the patient must be subjected to strict isolation, and preferably cared for by a special nurse. Bath water should contain a few drops of a weak solution of mercury bichloride, and every blister should be periodically removed by sterile forceps, and the base painted and dressed with 2 per cent white precipitate ointment, with 5 per cent $AgNO_3$, or gentian violet. The use of adhesive should be rigorously avoided, as it often forms a path of least resistance for the spread of the lesion and results in the loss of the affected epidermis upon removal of the dressing. An equally efficacious therapy consists in the application of dry heat to the base of the lesion, such as can be obtained from a carbon filament bulb fixed about 10 or 12 inches from the child's body, and applied continuously between feedings. An added precaution against the spread of the lesion consists in a thin smear of the white precipitate ointment to the healthy skin in the neighborhood of the eruption. It is essential, of course, to be continually vigilant for the appearance of blebs among "contacts," direct or indirect, particularly in the hospital nursery.

Pemphigus.—The border-line between *impetigo contagiosa* and *pemphigus neonatorum* is so shadowy that both lesions are classified by some authors as pemphigus—benign and malignant. True pemphigus presumes an increased number of vesicles and an enlargement and irregularity in the individual lesion. Exfoliation ensues in large confluent plaques, exposing the raw corium beneath; and the involved area both resembles in appearance and in its constitutional sequelæ a severe second degree burn. Although the occasional case recovers under treatment, the prognosis is very poor.

Closely related to this lesion is that of *dermatitis exfoliativa*, but here, in contrast to the vesicular lesion, there is diffuse reddening and swelling, followed by exfoliation. The staphylococcus is usually causative, and the frequent occurrence simultaneously of the pemphigoid and exfoliative lesions in the same epidemic further points to a common etiological basis.

Furunculosis.—The more benign staphylococcus lesions of early infancy occasionally become deep-seated, resulting in a true furunculosis, at times with an associated adenitis. The cervical glands react especially promptly to the neighboring lesion. Drainage should be effected in the individual lesion as soon as suppuration occurs, and every effort made to prevent contamination of surrounding parts. An autogenous vaccine is recommended by some, and is injected at three-day intervals, beginning with 3 minims and increased by 1 minim at a time until a febrile reaction ensues, when the dose is slightly reduced and repeated at weekly intervals for four to six weeks, if necessary.

Erysipelas.—Erysipelas is so constantly manifested in the skin that it is better mentioned here than under the heading of sepsis, where it really belongs and where it is the outstandingly serious *streptococcus* infection of the skin, whether in infancy or maturity. The infection is probably derived ultimately from lochial secretions which harbor the organism and a few cases have been noted at birth.

Coming on at the end of the first week or thereafter, the original foci occur most commonly at the navel or in the genitalia. The red, tender swelling usually spreads downward, but the advancing edge of the infection is less sharply defined than in the adult. Vesicular, suppurative or even gangrenous change may ensue quickly, and the constitutional reaction is usually severe.

The mortality-rate is about 95 per cent with pyemia, peritonitis, or an overwhelming toxemia as the terminal event.

In addition to the all-essential isolation, general therapeutic measures include the maintenance of nutrition and fluid exchange, antipyretic drugs and transfusion; to the external lesions, ichthyol compounds or saturated magnesium sulphate dressings are most commonly applied.

Sclerema.—Sclerema constitutes that type of skin disease characterized by induration, local or generalized, and is usually attended by icterus and a subnormal temperature. It may involve particularly the adipose tissue wherein chemical analysis yields a high stearin content, and in such cases the calves of the leg and the face seem especially predisposed. In other cases an edematous element is included (scleredema) and the lower half of the body is most frequently affected. Both types occur regularly in debilitated and premature infants, but it is not settled as to whether the lesions represent an independent disease or are a secondary manifestation of a more deep-seated pathology. Treatment is symptomatic—heat application, circulatory stimulation by massage and attention to the nutrition; but the mortality-rate remains very high. *Scleroderma*, on the contrary, carries a favorable prognosis and consists solely in small, reddened and infiltrated areas—definitely demarcated and self-limited.

Simple localized edema other than caput formation is ordinarily limited to the external genitals, and is more often seen in female than in male children, except in cases of of frank breech presentation, where swelling of the scrotum is a constant feature. The rarer instances of congenital

edema, of which the best known is *hydrops fœtus universalis*, are of doubtful etiology. In the lesion mentioned serous effusions accompany the indurated subcutaneous swelling, and there is over-development of the hematopoietic system. An association with maternal nephritis has been noted, and such is in keeping with the tendency to prematurity; but the condition at times involves the mature fetus and results in such enlargement that fetal dystocia may follow. In such cases the placenta is generally of excessive size. These children practically never survive.

CONGENITAL ABNORMALITIES.

It is impossible to present this subject with any degree of completeness, else it would become an exhaustive treatise upon embryology. However, certain conditions are so relatively frequent that they deserve mention.

It is stated that constrained positions *in utero* may be productive of abnormality in the skeletal system, for example, scoliosis and thoracic alterations. The constriction of growing tissues by the umbilical cord and by amniotic adhesions is recognized, and the end-result depends upon the factors involved in the individual case. But the vast majority of all congenital abormalities, quite apart from the rare anomalies mentioned, are referable to deep-seated defects in development occurring in the very early weeks of pregnancy.

The commoner skeletal alterations are classified in a general way as follows:

Amelia—congenital defect of all the extremities.

Ectromelia—congenital defect of one or more of the extremities.

Hemimelia—rudimentary development of distal portions of the extremities.

Phocomelia—rudimentary development of proximal portions of the extremities.

Oligodactylia—deficiency in the number of digits.

Polydactylia—excess in the number of digits.

Supernumerary fingers or finger-buds should always be examined at birth. Usually the base is free from bony connections, in which event a silk tie around the base will be followed by desiccation and sloughing without scar formation. Snipping off the digit at birth, followed by cauterization of the base, will sometimes be complicated by bleeding, and, later, scarring. If a true bony connection exists roentgen-ray is indicated before surgical treatment is instituted.

Pes Varus Congenitus (Congenital Club-foot).—The attitude of the fetus *in utero*, which often tends to approximate the plantar surfaces of the feet, will frequently persevere after birth. This condition readily adjusts itself, but a true adduction is always treated early, and it calls for manipulation and fixation of the affected part by a trained orthopedic surgeon.

Other joints are rarely affected by ankylosis, abnormal angulation and contracture.

Congenital Dislocations.—The hip-joint is the only common example of this lesion. Early diagnosis is greatly aided by the roentgen-ray. Most authorities recommend early operation, but the prognosis for good ultimate function is always doubtful.

Rickets.—The view is held by some that the disease may begin in fetal life, because of the occasional evidences of skeletal alterations at birth (craniotabes, wide sutures and fontanelles, enlarged costochrondral junctions), which under the care of some observers have cleared under rigorous antirachitic treatment, and have either persisted or progressed without such interference. Most observers, however, deny its possibility and consider that what was formerly designated as rickets is really chondrodystrophia.

Fetal disease of the skeleton further than this is classified under two general headings.

Chondrodystrophia.—This relatively rare abnormality is chiefly characterized by a shortening of the long bones, producing a disproportion between the lengths of the trunk and the extremities. Thickening of the extremities and of the

fingers usually accompanies the shortening; the head is large, the lips are thick, the mouth is held open, the tongue protrudes and the abdomen is usually distended.

This disease is produced by an inhibition of epiphyseal growth, while the periosteal development is unimpeded. Although prematurity and still-birth are frequent, many such infants survive, and are later known as chondrodystrophic dwarfs, which often tend to marked muscular development and increased fertility. The latter is of great importance as the abnormality tends to be hereditary.

Osteogenesis Imperfecta.—The essential lesion here is abnormal brittleness, thinning or softening of the skeleton, resulting in bizarre deformities and fractures, but with a rapid healing (calcified callus) tendency. Periosteal bone development is disturbed, but the epiphyseal lines are unaffected. True micromelia is absent, in spite of secondary shortening caused by healed fractures. The prognosis for life is very poor, and most cases succumb at about the time of birth.

Inflammatory Lesions.—Very occasionally instances of osteomyelitis are reported in infancy, usually in association with preëxisting sepsis in the child or the mother. Periarticular abscesses (most commonly of the hip) have followed infection with erysipelas, meningitis or peritonitis. The occasional instance of gonorrheal arthritis following ophthalmia ordinarily yields to expectant treatment. Joint manifestations of general sepsis are rare in the new-born and acute rheumatic arthritis is practically unknown.

CHAPTER XIII.

THE PREMATURE INFANT.

Prematurity and its management is one of the most delicate pediatric problems, and often calls for the highest degree of professional skill and resourcefulness. After a considerable experience, most obstetricians have adopted the practice of turning over the management of such children to the pediatrist, for eternal vigilance is the price of success.

Any child born prior to full term is, strictly speaking, premature; but for purposes of standardization the weight is the best criterion for its determination. For practical purposes 1500 gm. and 2500 gm. are arbitrarily chosen for indicating the upper and lower limits of prematurity; but it frequently happens that a child of lesser weight may show a relative excess in vitality over one weighing more at birth. In other words, variations in "constitution" are as clearly evident in early infancy as in adult life. It is likewise true that infants born at term will occasionally show the characteristics of prematurity. For these reasons it is erroneous to contrast too closely the premature with mature constitution. Reckoning both types from the date of conception, the former is handicapped by simple organic immaturity, which is sharply distinguished from the defective vitality of a pathological nature. Thus, the "vitality potential" of Pfaundler (weight increase of the premature child per unit of body weight in unit time) compares favorably with that of a full-term infant; but whereas the former is "younger" and better equipped with the potential of growth, it is less favorably adapted than the latter to the demands of extra-uterine life.

Moreover, pathological factors are often added, *e. g.*, developmental defects, congenital debility and the effects of maternal disorders—syphilis, nephritis, cardiac disease, wasting disorders, acute infections, traumata and intoxications.

The appearance of the premature child is fairly characteristic. The deficient development of subcutaneous fat gives to the thin skin a wrinkled and prematurely old appearance. A high color, approaching the cyanotic tinge, is common and is frequently complicated by icterus. Lanugo persists in larger amounts and in more extensive distribution. The mammary gland tissue is hardly palpable and the testes in male children are frequently undescended. Skeletal signs are inconstant.

Maintenance of body heat is the *sine qua non* in the care of such an infant, as excessive heat loss is favored by the relatively large skin area, the deficiency in subcutaneous fat and the immaturity of the central regulatory mechanism. The incubator is recommended by some; others prefer a small, especially heated room, preferably well isolated from the rest of the nursery. In the absence of either, a protected crib, continuously warmed by the electric pad or by hot-water bottles, is a reasonably satisfactory alternative. The body heat is also conserved by the use of cotton-wool jackets covering the whole body and head, with the exception of the face. Manipulation of the child is reduced to a minimum, except for routine care, and the interference necessary for stimulating defective respiration (cutaneous stimulation, artificial respiration, hot tubs). Oily applications to the skin are preferable to water for bathing, both for the prevention of irritation and of heat loss.

Another point of importance which further justifies extreme care in manipulation consists in the liability of the premature child to intracranial injury, which may present very little symptomatology in the beginning, but which requires the careful management heretofore described.

The inadequacy of the central nervous system is further

manifested by the constant stuporous reaction, where muscular movement is infrequent and feeble, the cry is only a whine and the respirations are shallow and irregular, with insufficient expansion of the lungs and inadequate respiratory interchange. Long periods of apnea, resembling Cheyne-Stokes respiration are not uncommon. When this sign becomes persistent or aggravated artificial stimulation, often by tubbing, is indicated as an emergency measure. The same atonic state is often responsible for the aspiration of milk or vomitus, in turn aggravating the cyanosis, and predisposing to pulmonary infections along with the atelectasis. Cyanotic attacks are frequently shortened and reduced in severity by the early administration of oxygen and carbon dioxide. The tank connection is led to a small glass funnel, which should be inverted over the face as frequently as necessary, the gaseous stream being applied at the rate of about 15 to 20 bubbles per minute, as indicated by the passage of the gas through a water bottle interpolated in the system. Continuous oxygen may be given by the in-dwelling nasal catheter if necessary.

The relatively high caloric needs of the premature infant have been mentioned. Extremes of 110 to 200 Calories per kilo of weight are considered as the optimum intake. Fortunately the necessary digestive enzymes are normally present in the infant of six months' intra-uterine development. Doubtless, the assimilative mechanism is less perfect, and is more frequently responsible for dietary disorders. Thus distention, vomiting and cyanosis frequently call for dietary modification, which, in view of the high caloric needs, creates a complex problem.

In the better-developed premature infant actual nursing is desirable provided the child obtains a reasonable quantity of milk, while the maternal stimulation is an added advantage. Frequently, however, the food has to be administered by other means. In all instances a breast-milk diet is almost imperative. While the initial feedings in very small infants

may require dilution, it is often desirable to add carbohydrate in order to furnish a greater concentration in small bulk.

Among the methods of food administration, it is wise to begin with breast milk in a miniature nursing bottle, which is the most satisfactory device, if it is tolerated. Occasionally the Breck or Boston feeder is better adaptable to a finer regulation of the intake, while the use of an ordinary medicine dropper is a satisfactory alternative.

Intervals of feeding should approximate the normal schedule for term infants in so far as possible. Unfortunately this ideal is rarely attainable, and in such circumstances smaller amounts given frequently yield the best results. The principle of working up from restricted quantities and weak solutions is particularly imperative in the case of the premature, but as the tolerance increases, the formula may be strengthened and the feeding interval may be lengthened.

In the rare cases in which the diet must be entirely supplementary, weak solutions of fresh cow's milk with added carbohydrate, or a selected milk powder formula, are the most useful substitutes for mother's milk. Buttermilk, with added sugar, is occasionally better tolerated.

It is clear that the program of nursing care as we have outlined it is most exacting, and the employment of a special nurse of the highest intelligence and conscientiousness is strongly urged. It is to be emphasized further that the greatest dangers to the premature child lie within the first hours and days of life. If this point is safely passed the hope of a successful issue increases tremendously and the prospects of subsequent normal development are greatly enhanced.

Instances of the successful rearing of incredibly small children are recorded. The prognosis for an infant less than 1500 gm. is very serious, but every 100 gm. above this point favors the outcome, with due regard to individual variations of constitution. The signs of progress are the increase in weight, which in the first month is relatively retarded; the temperature stability; the character of the cry; the loss of

somnolence; the development of the reflexes; the resistance of the skin; and the general signs of well-being.

In addition to the *relative* defective vitality of every premature child, there may be superadded, or there may occur in any new-born, a true defective vitality (congenital debility). This represents an inheritance from the parents, and may be due to existing parental disease or to toxic influences of lesser specificity. Such disturbances are functional, and the condition is sharply marked off from diseases of specific etiology. This constitutional inferiority shows itself in a profound mal-adaptation to such environmental factors as ordinarily promote the infant's welfare. Thus, the diagnosis of true debility must often be a deferred conclusion, since there are no characteristic signs at birth. The mortality-rate is very high in this unfortunate group of cases.

Somewhat related to this group are: (1) The occasional case of congenital *myxedema;* and (2) *mongolism.* The latter condition is recognizable at birth by the typical "idiot" reaction, generalized atony, broad nose, narrow eye-slits and hypertrophied tongue. Neither one of these conditions, in itself, offers any immediate problem; but at a later date the physical, intellectual and sexual development is extremely retarded in the occasional case that survives.

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